

# 1997 [NRAO](#) Users' Committee Report

Final Version --- 6 July 1997

## Introduction

The 1997 National Radio Astronomy Observatory (NRAO) Users' Committee appreciates the efforts that the NRAO made to prepare for the 1997 Users' meeting. The committee thanks NRAO for a well organized and informative meeting, held in Tucson, Arizona on June 5 and 6.

Despite a continued difficult fiscal environment the NRAO has accomplished a great deal in the past year. These accomplishments include: the inclusion of the initial detailed design and development phase of the Millimeter Array (MMA) in the [National Science Foundation's](#) submission to the fiscal year 1998 Presidential budget; a detailed site selection for the MMA at Llano de Chajnantor in Chile; an initial release of the beta version of the AIPS++ software package; and an improved efficiency in the operations of the VLBA. The committee also notes that NRAO is in general a well-managed organization, with a clear focus on providing the radio astronomical needs of its diverse user community, through a general effort on continuous process improvement.

The following report summarizes the committee's comments, concerns, and recommendations on many aspects of the observatory's operations and future plans.

## General NRAO Issues

A general NRAO issue that the Users' Committee is concerned about is the potential impact of current contract difficulties between [Associated Universities, Inc.](#) and the [Brookhaven National Laboratory](#) (AUI is the parent organization of both the NRAO and Brookhaven). Given the recent actions by the Secretary of Energy to terminate AUI's contract to run Brookhaven, we are concerned about undue impact on AUI's management of the NRAO. Specifically, the Users' Committee would like to acknowledge the excellent management that AUI has provided the NRAO for nearly forty years. The Users' Committee would like to express its strong endorsement for the continued management of NRAO by AUI. AUI continues to provide to NRAO sound managerial leadership, and at an overhead cost rate that has been decreasing annually.

It is clear to the Users' committee that NRAO needs a better policy on the use of outside instruments.

Outside user instruments were mentioned under both the 12m and the 140 ft telescopes in different amounts of detail. The committee strongly urges NRAO to allow the development of user-owned, observatory maintained hardware (which any outside investigator may propose to use). The biggest impact on the observatory (as opposed to individuals who want to do something with an instrument built by someone else) is the cost and commitment that NRAO needs to make to maintain this new hardware (see 140-ft section).

## Long Range Plans

The NRAO's long-range goals have three major focuses: (1) to finish the construction of the Green Bank Telescope (GBT), (2) start the development of the Millimeter Array (MMA), and (3) prepare for a major

technical upgrade to the Very Large Array (VLA). The Users' Committee concurs with these priorities, though there is concern that the continual slippage of the GBT completion schedule may impact on the time scale for starting both the MMA and the VLA upgrade projects. The Users' Committee is quite disappointed that the useful operational start for the GBT is now 1999. NRAO must continue to work closely with the GBT contractor to ensure that the telescope construction stays close to the defined schedule.

## **Budget**

NRAO continues to operate in a difficult fiscal environment. Financial support from the NSF has been reduced by nearly 10% in real dollars since 1993. NRAO has also assumed additional responsibilities during this time for the operations of the VLBA, and shortly will have to address the operational costs of the GBT and the MMA. The continued high fraction of the NRAO budget that is being spent on staff salaries has required a large reduction in the amount of funds available for hardware development and general capital procurement such as workstations. Despite the general budget reduction NRAO has managed to continue with the operations of its diverse telescopes. Mounting pressure on staff members in terms of increased staff duty requirements for NRAO's expanded operations, and low or no salary increases are a concern. The committee understands the operational necessity of holding back salary raises in a single year or two in a tight fiscal environment, but wants to express concern about the long-term effects on staff morale, retention, and general observatory operations if these hold backs are maintained indefinitely. We strongly encourage NRAO to make judicious staffing decisions, but to support current staff through appropriate compensation.

NRAO has done an excellent job of supplementing its support from NSF through outside contracts primarily through the sale of its HFET amplifier technology developed at the Central Development Laboratory. Additional support of NRAO activities has come from the use of NRAO staff in support of large capital projects such as the VLBA, and the GBT. The start of the MMA is encouraging in that additional NRAO staff will be able to work on the development of this most important scientific instrument.

## **Large Survey Projects Policy**

The Users' Committee was pleased to see that the NRAO did follow up on last year's recommendation to study the policy issues for large surveys on NRAO telescopes. We strongly endorse the report and recommend that NRAO implement the policy immediately. The Bridle report of January 1997 succinctly identifies the critical issues for the use of NRAO telescopes in large scale survey projects recommending that NRAO establish a policy for large scale projects. This report is available on the web at <http://www.nrao.edu/>.

## **Dissemination of Information**

It is imperative that NRAO continue in its tradition of good, open communication with its user community. Last year the Users' Committee recommended increasing the use of list servers as a means to disseminate information to the user community. NRAO should continue to make progress in this area. Also, general observatory information, including documentation, technical reports, manuals, etc. should be available via the Internet. The inclusion of XHELP within AIPS is a clear example of type of on-line support that NRAO should continue to develop within all its operations.

The committee was pleased to see that NRAO has developed its own Intranet via a commercial service contract with ATT. This internal network capability has vastly improved network communications across the observatory, particularly to sites like Green Bank. The committee strongly recommends that the observatory add additional

bandwidth capacity where needed and as demonstrated by careful monitoring of internal network traffic.

## **Educational Outreach**

The scientific community has a clear obligation to improve its community relations to explain why the science we do is important to our society. The interaction between scientists and the public is dangerously small and scientists cannot expect continued public support without a real commitment by themselves to communicate with the public. This was strongly articulated by NSF director Neal Lane in his June 1996 article in *American Scientist* and his August 29 1996 speech to the Arlington Rotary Club:

*"There is very limited public understanding of science...I believe that the new leadership needed from the research community is to carry our understanding of science and its value into the life of our own communities...[I stress] the importance of scientists getting out of their labs, off their campuses, away from their computers, and into a dialogue with the American public...Everyone, scientists included, should be able to explain what they do and make it sound sensible or relevant. If I were a surgeon, or a plumber, or a journalist, or even a musician, I could report on the kind of surgeries, leaky faucets, news stories, or compositions I had worked on...Maybe the most important goal should be to understand the physical, moral, and social problems that hold us in the grip of numerous contradictions. Surely we can only do this together, through regular and open discussions."*

Next year, the Users committee would like a specific agenda item and report on this topic. It should detail new policies by NRAO and how they have actually resulted in documented new activities in this area by NRAO scientists.

## **Tucson 12 Meter Telescope**

Tucson operations are split between continued support for the [12 Meter Telescope](#), and ramping up for significant support for the MMA project. The 12-m continues to represent an important single dish millimeter telescope for the general mm-wave astronomical community. Until the MMA is operating or U.S. mm-wave astronomers have access to a large single dish antenna, NRAO needs to remain committed to the support of this telescope. The committee is pleased to see progress in the 12-m in the use of the new 8 feed receiver and an improvement in the operations of the 200-300 GHz and 60-90 GHz systems. Due to continued short staffing in Tucson several projects are either behind schedule or on indefinite hold including getting a cold load common to all receivers, developing the wide-band continuum receiver from 70-90 GHz, and introducing a digital phase lock loop for better frequency switching. On The Fly (OTF) mapping has become a standard mode of observing with the 12-m providing the user community with impressive high signal-to-noise maps. The Users' Committee is pleased to see NRAO's efforts in providing a new 3 mm 8-receiver 4-beam system for the 12-m. The addition of a new correlator at the 12-m based on a cloning of the GBT correlator design is an excellent means of leveraging the efforts already put into the GBT development. The use of remote and absentee observing protocols at the 12-m and the software tools that have been developed there to support these observing modes are very important to the success of the Tucson operations. NRAO should use these tools as models for developing similar capabilities for other telescopes including the GBT and MMA.

Due to the difficult staff situation in Tucson and the limited likelihood for significant change the committee recommends that a long-term operational plan be developed for the 12-m and published. This plan should address the schedule for various receivers and back-end development efforts and coordinated projects with the MMA, and should cover a 10-year period, or the proposed useful lifetime of the 12-m telescope. The use of guest instruments should be strongly encouraged. This committee also strongly encourages the expanded use of the 12-m in mm-wave VLBI experiments, and sees no obvious reason to restrict mm-wave VLBI observations to only 1

week per semester.

As an aside, it is still a wonder to some members of the committee that NRAO has not attempted to create a common telescope control system, particularly between the 12-m and the GBT. Such an effort would be useful in controlling software development issues, and provide for a better software test environment.

### Green Bank

Last year this committee expressed concern about the number of Green Bank staff members. Now the Green Bank staff is as large as it has been since the mid-1980's. The observatory's housing and residence halls are nearing capacity. This represents a renewed vitality in Green Bank in preparation for the GBT "first light." The committee strongly recommends that additional scientific staff be placed in Green Bank to provide scientific support for the GBT. This can be accomplished by direct NRAO scientific hires, adding additional post-doctoral positions, and encouraging visitor or sabbatical positions. Green Bank should also make preparations for general remote and/or absentee observing as a standard mode of operation with the GBT.

### Green Bank Telescope

The additional delay in the scheduled completion of the GBT is a disappointment to the Users' Committee. We do, however, recognize that such delays are not entirely unexpected in the construction of such a large telescope of novel design, and we are satisfied that NRAO is doing its utmost to deal with these problems as they arise. The negotiations with the contractor, though difficult, have so far been successful in resolving issues of concern. While substantial progress has been made in the actual assembly of the telescope, the Users' Committee is concerned that it will now be well into 1999 before a useable telescope is available. This may require NRAO to rethink the scheduled closing of the 140-ft until after "first light" with the GBT.

The committee would still like NRAO to hold a well-advertised workshop on science with the GBT as mentioned in the 1996 report. Such a workshop would serve to advertise the technical capabilities of the GBT and provide the observatory with a good idea about initial GBT projects and their technical requirements.

The operation of the GBT control mock-up has begun this last year, after the full complement of 140-ft operators was finally attained. This is a definite advance in the move from the 140-ft to the GBT, and has addressed a concern from the previous committee report. This simulator is an excellent means to test the GBT monitor and control system, train operational personnel prior to actual use on the telescope, and will lead to a faster initialization and shakedown phase of the telescope commissioning.

The NRAO should continue to closely monitor and report on problems and progress of the GBT construction to the committee and the community. The resonance response of the GBT and the impact that this will have on pointing and focusing of the instrument, particularly at high frequency, is a question of concern. The committee was pleased to learn that the IF optical fiber cable gain variability problem has a likely technical solution. Improvement in the cable-wrap system and the addition of automatic gain control may provide a solution to this problem.

### 140 Foot Telescope

The Users' Committee would strongly encourage NRAO to continue operations of the 140-ft until the GBT is on-line. This may require reopening the proposal process for the 140-ft. The committee strongly recommends allowing new proposals to be submitted for use of the 140-ft, if the telescope will remain operational until 1999.

Additional general observing with the 140-ft will need to be coordinated with SETI.

The Users' Committee endorses the use of user supplied NRAO maintained equipment at NRAO facilities. The use of these additional systems will provide general NRAO users with more flexible choice in observing options, provide NRAO a means to get additional hardware at no or low cost, and provide an excellent opportunity for students to develop hardware. Clearly NRAO should expect certain minimum levels of stability, documentation, and technological compatibility with existing NRAO engineering staff and equipment.

### Very Large Array

The VLA continues to be the main instrument for NRAO operations. The NRAO receives a steady proposal submission rate of about 200 proposals per trimester with over 75 percent submitted electronically. The recent completion of the two major large surveys in B and D array will represent a great relief in proposal pressure that has accumulated over the past several years while these surveys were undertaken. The on-line availability of the data from these surveys has already represented a great boon to both the radio astronomy and general astronomical communities.

The committee supports NRAO's process of accepting Target of Opportunity proposals. We concur that a reasonable fraction of these proposals has paid off with significant detections or interesting results. [While this comment came up in reference to the VLA it certainly applies to NRAO's other telescopes as well.] There was some discussion of the present treatment of the refereeing and scheduling of long-term (more than 3 years) monitoring programs. A secondary issue associated with long-term monitoring projects is the time scale for public release of the data. It was urged that NRAO investigate options for formal monitoring programs in a manner similar to the recent large-proposal study. No consensus was reached at the users' meeting on the necessity, merits, or details of such a change in policy.

The addition of the full complement of Q-band receivers on all the antennas will represent a significant new capability for the VLA. The possibility of widening the VLA's IF pass band from 50 MHz to 80 MHz represents a significant additional capability for the array. Receivers for a complete 74 MHz system are being installed on all 27 antennas through the support of the Naval Research Laboratory and the assistance of Bill Erickson. The committee is pleased that NRAO is close to finishing up the tape copying of the entire VLA archive data set. The next step is to transfer the uniformly formatted archive from 8mm tape to a more permanent media such as CD-ROM (though by the proposed time of this conversion, newer high-density media such as DVD may be more appropriate).

Registration forms for visiting the Socorro site are now available on-line from the NRAO home page. The committee has recommended that similar on-line registration capability be developed for Green Bank, and the other NRAO sites.

Bringing VLBA operations on-line has necessarily resulted in decreased support for VLA observing. While support has remained generally good, in some cases things have fallen through the cracks, and the committee urges that better communication between analysts and users be encouraged, and perhaps that the less experienced analysts work alongside observers at the AOC to gain experience. It might also be possible to designate analysts as VLA or VLBA primary contacts rather than splitting their duties.

Some problems encountered with observing schedules could be avoided through an upgrade (or redesign) of the aging VLA OBSERVE program. The OBSERVE program has been a sore point with users for a number of years, and no progress has been forthcoming as of yet. We strongly urge that an up-grade in the OBSERVE program be made a priority, as it is often the first NRAO software that a novice observer interacts with from

NRAO. It is anticipated that if a new OBSERVE program (or interface) is pushed forward, this is probably a one-programmer project that could be completed within a year.

The NRAO has now tentatively scheduled the next tri-annual Imaging Synthesis summer school for 17-24 June 1998 in Socorro. It is expected that use of the new AIPS++ package will be emphasized at this workshop, with the idea of helping to quickly establish AIPS++ as the new standard synthesis program.

### Very Long Baseline Array

The VLBA is now conducting scientific observations about 50 percent of the time. In comparison the VLA conducts scientific observations about 77 percent of the time, according to the latest usage statistics. In order to improve the efficiency of the VLBA a number of items need to be implemented including multiple projects per tape and dynamic scheduling of the array. Dynamic scheduling will allow for a more optimal use of the array at the high frequencies. Dynamic scheduling is an underdeveloped activity that NRAO needs to address to improve the operating efficiencies of its telescopes. Dynamic scheduling could be used on the VLBA, the VLA, the GBT, the MMA, and the 12-m. Dynamic scheduling must be including as quickly as possible in order to develop the proper telescope operating culture. This is critical to optimally take advantage of every single second of telescope time.

The AOC correlation's group has done an excellent job to reduce the processing backlog, and the mean time between data recording and tape release has reached a steady-state limit at about 10 days. One trend of concern to the correlation group is that the average speed-up factor for data processing has reduced from 1.42 (April '96 - Mar '97) to 1.27 (current). This represents an increasing demand on the part of the users for slow correlation modes. If this trend continues there are concerns about increasing the backlog of tapes that need to be correlated.

The VLBA has decided to switch to recording data only with thin tapes as of 8 September 1997. The move to thin tape only will improve the detection SNR and tape efficiencies, as mixed media on the same drive resulted in significant playback degradation. This committee endorses this move, even though there will be some difficulty with propagating this change to foreign stations in the short term.

The committee is very pleased to see that NRAO is now making the commitment to develop the pulsar gating capability on the VLBA. A committee of interested pulsar astronomers will meet in late June to review NRAO's plans for implementing pulsar gating. The target date for general availability is 1st quarter 1998. Accurate time stamps of pulse phase are also an important element in the establishment of pulsar gating capabilities. The committee notes that burst mode VLBA observing should also be developed.

Some progress has been made on providing amplitude calibration information in the correlator output data. Currently, calibration is unnecessarily tedious and is no faster than in the old global array VLBI days. We urge that the improved amplitude calibration process be finished as soon as possible, and that other information, such as the atmospheric delay model be provided as needed for astrometric experiments.

A lot of the VLBA efforts in the past year and half have focused on the implementation of Space VLBI capabilities into the correlator and software. The correlator has been upgraded to read Mark IV data and AIPS has been upgraded to support SVLBI data processing. No fringes from HALCA have been detected through the NRAO correlator and software system, as of the June Users' meeting. This is an issue of some concern given the investment NRAO has made in SVLBI and the complexities of the systems. [The chair was pleased to learn that HALCA fringes were detected with the VLBA correlator data subsequent to the 1997 Users' Meeting.]

## VLA Upgrade

The VLA upgrade will clearly be the high priority project for NRAO in the next decade. It is also clear that many aspects of the VLA upgrade will depend on development efforts from the MMA. The main features of the VLA upgrade will include bringing the VLA's 1970's era electronics up to the level expected for a 21st century instrument, upgrading the VLA antennas with prime focus capability, a new antenna/feed leg design, and the addition of new antennas for an A+ array to fill UV-spacings intermediate between the VLA and the VLBA.

Two current efforts are underway requesting support from the NSF to compete the Q-band systems and to provide a link between the Pie Town VLBA antenna and the VLA site. The projects are currently submitted to the NSF awaiting response. Of particular concern to the NRAO is the identification of a partner who can support \$200,000 for the Pie Town link to the VLA. The Users' Committee would like to see the NRAO quickly identify a partner to take advantage of this important opportunity to increase the imaging performance of the VLA.

## **Computing Infrastructure**

The general computing situation at NRAO has improved in the past year with the addition of numerous new workstations at the major observatory sites. The observatory is also aggressively pursuing a means to provide new desktop computers for most of the staff, who are currently using older SUN SPARC class systems. The new systems are targeted to be in the under \$4K price range. The general objective is to reduce the observatory wide computer replacement lifetime from 10-15 years down to 5-6 years. The target budget for computing hardware across the observatory is about \$500K per year.

The committee strongly encourages the observatory to move toward a more responsible and secure computing network. The primary means of controlling unauthorized access to NRAO systems is to force full password encryption over the Internet. This will eliminate the possibility of password snooping over the Internet. The use of secure shell (ssh) is an effective and easily implemented procedure. While this technology may initially represent an additional overhead on the part of users' access to NRAO's computers it represents an important security step to take in order to authenticate and control unwanted access to NRAO's systems. It is important to begin implementing these additional security measures before NRAO is hit by an unfortunate break-in or computer hack.

## AIPS

The Astronomical Image Processing System (AIPS) continues to be the primary software package for the reduction of VLA, VLBA, and SVLBI data. NRAO is continuing to maintain and enhance this package while simultaneously developing the new generation package AIPS++. With AIPS now installed at over 200 sites world wide it represents a very important astronomical software tool. The latest release (as of June 6) is 15OCT96 with the 15APR97 release scheduled for July 1997. The 15APR97 release will have additional routines specifically for SVLBI. Due to the continuing development of image processing capabilities within the new AIPS++ package, the committee strongly encourages the NRAO to set a time schedule for merging both the AIPS and AIPS++ software development groups and the software packages. The committee is pleased to see that an effort is now being applied to address the parallelization of AIPS routines to take advantage of the new RISC based scalable multiprocessor architectures provided by most workstation vendors.

Much of the AIPS development effort for new observing modes has been in improvement of the "core" CPU-heavy tasks such as IMAGR. This is appreciated, but some users find that insufficient attention has been paid to interactive tasks such as editing (TVFLG) and command help (limited search capability), which can consume much overhead time. Many of these interactive programs have been essentially unchanged since their inception many years ago. LISTR is an extreme example. This committee urges that key user interaction-intensive tasks be included in the "core" routines that are slotted for upgrade, as AIPSmasks do not always reflect the true

expenditure of time.

## AIPS++

The Users' Committee found that substantial progress was made on AIPS++ in the past year. The significant milestone of a limited beta release was passed in February 1997. Several important synthesis-imaging tasks were implemented, and the ATNF group has successfully used AIPS++ as a base for their Parkes multi-beam control and analysis software. These long-awaited advances are to be applauded. A second beta release is scheduled for early summer 1997.

Clearly the next milestone is the proposed version 1.0 public release currently scheduled for the fall of 1997. With this in sight, every effort should now be made to achieve this on-schedule. Although a number of consortium and outside members have been providing substantial feedback on the beta release, overall there has not been enough astronomical input into the AIPS++ program. We suggest that during the months leading up to the 1.0 release, particularly during the summer of 1997, a series of "beta tester workshops" be held at Socorro bringing together face-to-face the programmers and a group of "expert users" in order to exercise and debug the package. This will bring out the improvements needed to make a functional program and to point out future areas for development. It is absolutely essential that real operational users begin working with AIPS++ as soon as possible. This will force the package to confront real operational issues and will force a higher level of responsiveness on the part of the AIPS++ development group to real user demands.

The AIPS++ package as a whole seems to work well. Some specific issues were brought up by the committee and should be addressed in the first public release. Issues that the committee is concerned about include speed, memory and swap requirements, and shared-library compatibility. The AIPSview display should be replaced with a more reliable display package that is better tailored to use in a synthesis-imaging suite. The glish interface is non-intuitive at first encounter, and members of the committee had conflicting opinions on its merits and flaws. GUI and mid-level command overlays should be provided to hide the raw glish from sensitive or c-phobic users, and more attention should be paid to user interactive tasks such as data visualization and editing (e.g., TVFLG). It is hoped that the flexibility laboriously built in to glish and AIPS++ will be exploited in the upcoming release to fulfill the various requirements of large surveys, deep single-source observations, and single dishes. The committee also strongly recommends that the AIPS++ development group start to immediately benchmark the current AIPS++ code in terms of memory requirements and floating point operations. These measures will be very useful to monitor the improvement in the code performance across successive releases, and compiler upgrades. It will also be useful to use these numbers to compare other software packages.

A very exciting new development in AIPS++ is the possibility of including an AIPS wrapper that will allow an AIPS++ user access to the full functionality of classic AIPS. The committee feels that this feature alone represents a major milestone in the software development project and will quickly force the merging of both AIPS and AIPS++ packages and their respective software development teams. The AIPS and AIPS++ program manager should begin working on a plan and schedule for merging these two activities as soon as possible. The use of the wrapper tools may also provide a way to bind other software packages to AIPS++ such as IDL. While binding IDL is not a current priority for the AIPS++ development group it represents an interesting future possibility.

The committee was disappointed to see that no published scientific result has yet emerged from data processed through the AIPS++ package, as expected following discussion from the 1996 Users' meeting. We are hopeful that such a result will be achieved prior to next years Users' Committee meeting. The committee would also like to see more project management information regarding the AIPS++ project along the lines shown for major projects like the GBT construction. A clear delineation of functional tasks, with estimated cost (hours of efforts), schedule, and testing status would provide a much better estimate of the size and scope of the software



development effort remaining to be completed.

The committee recommends that all the AIPS++ documentation be maintained in an easy to access on-line, web browsable database, fully indexed for easy searching with a web based search engine. It appears that a good start has been made in the current documentation suite, and that the Users' Committee expects this trend to continue.

NRAO needs to push for more internal support by NRAO staff (particularly at Socorro) for data processing within the AIPS++ package. Internal NRAO users should be working at testing, debugging and improving the AIPS++ package for their own scientific research. We note that this has been a problem even for old AIPS, and hinders the progress of software development as well as stymies visitors who are looking for help using the latest programs. NRAO should work hard to get its own internal scientists to use the AIPS++ as a matter of routine (especially the veteran members of NRAO who are reluctant to embrace the newest programs). It is inappropriate to ask the user community to exercise new programs when NRAO staff still are using other or older packages. The lack of a published AIPS++ result is indicative of this problem, and should be rectified.

## [MMA](#)

The allocation of NSF funds for the first phase design and development (D&D) of the MMA is encouraging news to the astronomical community. The plan is to review NRAO's D&D work prior to the approval of the six-year phase 2 construction period. Although the 3 year D&D timetable will push the resources to the limit in order to prototype the array systems, we are confident that this can be accomplished by NRAO in conjunction with the Millimeter Array Design Consortium (MDC). The plan presented by R. Brown was sensible, and should provide the necessary design results in the allotted time frame.

The NRAO should also remember that considerable expertise in mm-wave interferometry exists at a number of major U.S. universities. NRAO should be prepared to use the expertise and resources available at these universities to supplement its rapid design and development program for the MMA. This should be carried to the construction phase when the MMA is approved, where possible, as this could help keep the university based millimeter astronomy community vital during the long phase leading up to MMA "first light." Since NRAO has decided to develop the MMA as a decentralized project, the NRAO should be very careful monitoring the project status and accomplishments.

The choice of the Chajnantor site in northern Chile as the MMA location has been well supported with site testing and exhaustive studies by NRAO, and is thereby endorsed by this Users' Committee. NRAO needs to make sure that negotiations between NRAO and CONICYT, and the two respective governments, proceed at a timely pace. The NSF mandate to find 25% non-NSF partners for the MMA is worrying in the current economic climate abroad, as well as given the competitive interests of otherwise possible partners such as the Japanese and Europeans. The Users' Committee will watch developments in this area with interest, and urges NRAO to continue to pursue this with other US organizations. In particular, clearly there are many areas of overlap between the MMA and the NASA Origins program, and we strongly endorse a financial partnership between NSF and NASA to fund the MMA. It would be encouraging to see the highest levels of the NSF and NASA come to an agreement for cooperation. It will be good to see this last big project highlighted in the Bahcall Decade report underway, and we fully expect the MMA to be the top of the list in the upcoming Decade report. It was suggested by the NRAO group that a second MMA Science Workshop be held in 1998 (the last was in 1995) to prepare a document suitable for the upcoming review. This would also be a good opportunity to bring in researchers and administrators involved in the NASA Origins program, as well as NSF personnel, to see what common goals can be served by partnership.

## [Central Development Laboratory](#)

The continuing development of high-quality cutting-edge astronomical technology from the CDL has impressed the committee. The new tunerless mixers, sideband-separating mixers, balanced integrated IF Amplifiers, and high-frequency HFET amplifiers reported on by J. Webber were good examples of the important work going on at NRAO in these areas. In particular, support of the CDL for the new GBT and MMA receivers has been superb. The contract between NRAO for CDL to supply NASA MAP project with a large number of HFET amplifiers has provided NRAO with state-of-the-art test equipment and enhanced capability for the fabrication of high-quality low-noise amplifiers.

The use of MMA development to augment VLA upgrade and Tucson 12-meter systems is also applauded. Clearly all groups in the NRAO sites are in good communication on these developments, and this work is benefiting the users of a number of instruments.

This committee feels that it should be noted that NRAO not only supplies its users with high-quality astronomical facilities, but is also essentially the only source for microwave and millimeter-wave low-noise research grade HFET amplifiers. A number of University groups (including some represented on the committee) rely on the NRAO amplifiers to carry out astrophysical research and construction of new instruments, and NRAO should recognize these as "users" also. The CDL has been very supportive in the past, but some worry has been expressed with the delays introduced by the taking on of the NASA MAP project. We urge that NRAO be careful to not let large (and richly funded) outside contracts interfere with previous commitments (often informal) to the smaller user-based efforts that rely on these devices. We do feel that the NASA MAP project will end up vastly enhancing the capabilities of the NRAO HFET development group and that few long-term delays will be caused by this interruption, but the CDL should keep this in consideration for the future.

### **Radio Frequency Interference**

NRAO in Green Bank has established a formal RFI board at the site to deal with all issues of RFI. Members from all the site divisions participate on this board. This is a very important group to address the issue of RFI, and in particular to work at controlling site generated RFI. We urge NRAO to institute similar RFI boards at the VLA and 12m, following Green Bank's lead, to take a more aggressive stance towards RFI. The three boards should interact with one another on areas of mutual concern.

The observatory will be conducting significant RFI tests on the 5 Iridium satellites launched recently by Motorola. These are the first of what will eventually be a constellation of 66 satellites that will operate in the 1621- 1625 MHz band just above the 1612 MHz OH band. The observatory will work to assess the impact of out of band emission from the Iridium satellites on the radio spectrum. The Users' Committee strongly encourages NRAO to devote all necessary resources to these tests and to the quick analysis and release of the test results.

Concern is expressed regarding NRAO's cooperation with other national and international radio astronomical organizations regarding RFI monitoring. We strongly encourage NRAO to interact on a regular basis with NAIC, particularly in regard to spectrum management. NRAO should be at the forefront of protecting parts of the spectrum that are just beginning to become available (the mm band). The 12-m and MMA planning staff should include groups that will be involved in petitioning for new astronomy bands in the mm-wave region -- the commercial sector will not be far behind!

### **Committee Matters**

The committee chair for 1998 will be Don Backer.

*Roger Foster, Chair*