2000 NRAO USERS COMMITTEE REPORT August 14, 2000

Executive Summary

The Users Committee was very impressed by accounts of NRAO's operation of the VLA and VLBA and by progress on the GBT, ALMA and Expanded VLA projects.At the same time, we were greatly disappointed by the sudden, premature closing of the 12m telescope.We feel that the GBT project is at an especially critical phase, and that decisions made now about resource allocation and equipment development will greatly influence the ultimate success of this instrument.

Some of our principal recommendations are summarized below, not in order of priority.

* We urge the NRAO to cooperate closely with university-based consortia that propose to take over 12m telescope operations and to establish a cooperative agreement with the successful consortium to enable testing of prototype ALMA systems.

* We encourage the NRAO to seek continued collaboration with the university community, especially in the development of the ALMA and the EVLA projects. Such collaboration is essential to the success of these projects and to the health of the university radio astronomy community.

* We believe that the success of the GBT will be judged by its eventual performance at high frequency (3mm). Therefore, we encourage the NRAO to maintain a strong engineering capability to deal with mechanical, structural and dynamical metrology issues that are likely to arise during the commissioning phase. We also encourage the NRAO to plan for the commitment of resources that will be necessary to achieve 3mm operation once the initial commissioning at lower frequency is complete.

* We encourage the NRAO to give high priority to the development of the GBT high-frequency (68-95 GHz) receiver and to the 1.4 GHz phased array.We also ask for timely implementation of essential observing modes in the GBT correlator such as cross-correlation and synchronous pulsar time-resolved spectra.

* We are very encouraged by the detailed GBT commissioning plan.However, we recommend that proposals for commissioning-phase observations not be solicited until these observations can be scheduled with reasonable certainty.

* We encourage strong support for AIPS in the foreseeable future, and we encourage rapid development of the AIPS++ end-to-end processing of VLA data.

* We recommend that NRAO keep the user community well informed about decreased availability of the VLA during upgrade to the EVLA, should this

new project be funded.We endorse the skeptical review panel policy regarding large VLA time requests.

* We caution the NRAO not to submit the VLA Phase II (New Mexico Array) proposal prematurely in light of other capital investment proposals that are pending.

* We request a permanent NRAO Users Meeting web page. This page will solicit input to User Committee deliberations from a broader representation of the community and disseminate the community the results of the committee meetings.

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ALMA

The committee approves of the work NRAO has done with the university community, yet encourages even more collaboration.This will be especially important for the millimeter wave community with the loss of the 12m telescope.In particular, the university facilities may be able to provide locations for testing ALMA concepts if the 12m is not available for this purpose.

The committee encourages NRAO to actively pursue involving the Japanese in ALMA.

As in last year's report, the committee supports the idea of one TAC.

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12m/TUCSON

The User's Committee understands the budgetary constraints that led to the necessity of the premature closure of the 12m and its timing.However, the Committee deeply regrets the closure.The 12m has set a standard as an efficient, user-friendly, world-class telescope.The closure has severe consequences beyond the termination of scientific output, including: the lack of an ALMA technology testbed until the prototype antennas become available, the potential demise of a broad millimeter-wave astronomy user base in the US, and the disruption of Ph.D. dissertations.The 12m report stated that 96 students used the telescope from 1994-1998.

The Committee makes the following recommendations to minimize the consequences.

1.) Continue to cooperate with university based consortia that propose to take over 12m operations.This cooperation should be detailed and significant, extending to the NRAO Tucson staff helping to solve

occasionally-arising difficult technical problems for which an intimate knowledge of the equipment is necessary.The NRAO Tucson staff should also be fully available for consultation about technical issues with which they are familiar. An active, rather than a passive, degree of participation by NRAO Tucson staff will help bring the new staff up to speed and help keep the 12m to retain its excellent multifaceted role in single-dish millimeter-wave observations by the broad user community.

2.) Make a cooperative agreement with the new 12m consortium to enable testing of prototype ALMA systems.Under new directorship it should still be possible to test real-time software, optical pointing, use of the Quadrant Detector to monitor quadrupod motion, and correlation polarization techniques.These systems could be left operational at the telescope after testing to the benefit of the new consortium and the users.

3.) Consider whether correlation polarization techniques can be tested with the GBT.

4.) NRAO should seek funds to institute a small number of graduate and postdoctoral millimeter-wave fellowships offered annually.These fellowships will help continue the broad user base and millimeter-wave expertise in the US.These fellowships can evolve into ALMA fellowships when the array is operational, analogous to the prize fellowships awarded by the large NASA missions.The fellowships should be competitively available to all fields of millimeter and submillimeter astronomy: interferometery, spectroscopy, continuum work, and instrument development. They should be available to students and postdoc outside of NRAO to stimulate activity at universities.

The committee applauds the continued receiver development, computing resource improvement, and support of VLBI observations by the 12m staff in 1999-2000.

On behalf of the users, the Committee thanks the 12m staff and NRAO in general for observations and excellent support for the last decades.The resident scientists and engineers have enabled the growth and establishment of milimeter-wave astronomy not only in the US, but throughout the world. Many millimeter-wave astronomers have used the 12m and were trained with it.The staff at the 12m, as at all NRAO facilities, have always been dedicated, hard working, and first rate.The users will miss not only the telescope, but all the support and assistance of the staff.

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VLA

The Users Committee is pleased with NRAO's management of the VLA and with NRAO's increased emphasis on the expansion of the VLA's capabilities.There is some concern at the postponing of important VLA maintenance items such as painting and tie replacement due to

budgetary constraints.The Committee has the following specific recommendations concerning the VLA.

1.) The Committee recognizes the importance of expanding the capabilities of the VLA and the downtime necessary for such advances.The Committee recommends that NRAO keep the user community informed of any decreased availability in the VLA well in advance so that users can make necessary preparations.

2.) The Users Committee is impressed by NRAO's work on the VLA/Pie Town fiber optic link, which will increase the resolution of the VLA to nearly twice that of the A-configuration for northern sources. The Committee recommends that NRAO continue work on the basic capabilities of the link and calibration software in preparation for the upcoming A-configuration.Capabilities not yet available for the link (e.g. fast switching) should be implemented as soon as possible.

3.) The Users Committee recommends that NRAO continue testing of the Java-based scheduling software, JOBSERVE, and make it available to the community as soon as possible, preferably in time for scheduling observations in the upcoming VLA/Pie Town configuration.

4.) The Committee applauds NRAO's expansion of the VLA's high-frequency capabilities and recommends that NRAO continue construction and installation of new 22 and 43-GHz receivers as funding permits.

5.) The Committee recommends that NRAO continue work on expanding the capabilities of the current VLA data reduction path within AIPS++.

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EVLA

The committee enthusiastically endorses the NRAO Phase I plan to significantly expand the VLA into the EVLA.As the VLA digital electronics are of 1970's design and are becoming an increasing limitation upon array performance, the upgrade and expansion project is essential to the long-term scientific productivity of the array.We are also enthusiastic about the proposed inclusion of Canada and Mexico in the project.The Committee is pleased that this project received user input at an early stage, and is pleased that NRAO was prepared when an opportunity arose.We also look with interest upon the eventual Phase II plan to add eight new antennas and create the New Mexico Array.

We are concerned, however, that the Phase II proposal not be submitted prematurely, in light of the other NRAO capital investment proposals that are pending. The resources of NRAO are stretched thin in many areas, and we see difficulties ahead for NRAO and its users if the current overcommitment is increased significantly.NRAO should also consider the impact on University technical research groups of the financial drain on NSF to be

expected from concurrent ALMA, EVLA Phase I, and EVLA Phase II funding.We suggest that NRAO uses the time consumed by Phase I to refine the Phase II concept in concert with the University community.

We recognize that there are many issues yet to be resolved regarding the EVLA project.Apart from funding, these issues mostly involve the timetable of the project, the use of NRAO "redirected" resources, and the effects of the upgrade project upon continued functioning of the existing array.We encourage the NRAO to formulate and publicize as soon as feasible an implementation plan addressing these issues.Specifically, this plan should describe how the $11.2M in redirected resources will be spread out over the lifetime of the project and what the impact of this redirection will be upon other NRAO initiatives and operations. The plan should also describe as accurately as possible how and when the upgrade project will affect existing VLA operations so, for example, graduate students anticipating thesis work on the array can plan accordingly.

The Users Committee should be kept fully apprised of the progress on the EVLA project. If issues arise for which scientific input is needed, an EVLA advisory committee (patterned after the ALMA Science Advisory Committee) might be used to provide this input.We anticipate that the timescale for creating the EVLA will be significant compared with the timescale for the development of technology.Therefore we suggest that before Phase II of this project is proposed, a committee (like the committees that met before the development of the EVLA Phase I proposal) should be convened to address how best to accomplish the aims of the proposal with then-current technology.Among the issues to be considered are the technology for the 8 new antennas, in view of rapidly developing research around the world into innovative techniques for achieving lower costs per square meter of collecting area.

Finally, we encourage the NRAO to involve the university technical community as much as possible in the EVLA project, and the proposed advisory committee may wish to consider this possibility.

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VLBA/VLBI

The Committee applauds the recent efforts by NRAO to increase community awareness for the capabilities of the VLBA, especially through the VLBA topical session at the June, 1999 AAS meeting and through the development of a "Novice's Guide to Using the VLBA".Although the impact of these efforts have not been immediate, the Committee believes there will be significant long-term benefits in visibility and an increased VLBA subscription rate.The Committee has the following recommendations for NRAO with regards to the VLBA.

1.) The Committee recommends that NRAO continue its efforts in the areas of dynamic scheduling and automated calibration transfer which have

thus far resulted in increased VLBA usage and ease of VLBA calibration.

2.) There has been little response to the data calibration service offered by NRAO, although 1 year may not be a long enough period to constitute a reasonable test. The Committee therefore recommends that NRAO offer it on a trial basis for one more year.If it is still underutilized after 1 additional year, the Committee recommends that NRAO discontinue this service, and concentrate its limited resources on the ongoing development of usable calibration scripts for VLBA data reduction that will benefit all users.
Despite dropping the formal calibration service, the Observatory should do its utmost to help new users of the VLBA, and to encourage use of the Array by astronomers outside the 'black belt VLBI' community.

3.) With regards to the installation of 3mm receivers, it is the opinion of the Committee that the greatest benefit to the community would be realized by starting with a compact array. The committee therefore recommends outfitting antennas in the Southwestern U.S. first.
The Committee therefore recommends that NRAO place the MK 3mm receiver (in for upgrade) on one of these antennas (KP or OV), and that the first of the new MPI sponsored receivers be deployed to complete the Southwestern subarray.

4.) Since AIPS will continue to be the primary reduction package for VLBA data in the near future, the Committee recommends that NRAO maintain the current level of AIPS support.

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Large Projects

The Committee applauds NRAO for instituting a new format for the review of VLA proposals requesting large amounts of time and which therefore could impact a large fraction of the user community.The Committee considers the current process for the review of large proposals as one that should continue.The NRAO should continue to ask senior astronomers, potentially including a small number of those who are not traditional radio astronomers, to serve on the skeptical review panel.

The Committee also feels that the current limits on the amount of time allocated to large projects (10-20% of the total observing time and no more than 50% at any given LST) are reasonable.The Observatory and skeptical reviewers should, of course, remain flexible and allow particularly compelling large projects to take up more than 20% of the total observing time.

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Green Bank Telescope.

We were very impressed with the presentations about the GBT. Many receivers are ready, the backends are mostly ready, the plans for startup and operations appear to be well-laid. An orderly plan for developing the telescope's capabilities at increasingly higher frequency was presented.

The committee feels that the ultimate success of the GBT will be judged to a very significant extent upon its eventual performance at high frequency (3mm).Therefore, we strongly encourage the NRAO to maintain a strong engineering capability to deal with mechanical, structural and dynamical metrology issues that are likely to arise during the commissioning phase. We also strongly encourage the NRAO to plan for the commitment of resources that will be necessary to achieve 3mm operation once the initial commissioningat lower frequency is complete.

There are various technical areas that are NRAO's responsibility.We were somewhat concerned that the proposed schedule for dealing with those areas is optimistic.Optimism is good and necessary, but it should not adversely impact the announcements of GBT readiness to the outside world. Proposals, and in particular proposals during the commissioning phase. should not be solicited until there is a high probability of being scheduled on a predictable time scale.Specifically, we mean by this that if the call for proposals states that scheduling these proposals will occur during a given quarter or trimester, then there is a high probability that this will actually occur without delaying into the next scheduling period; and, also, that when an observer is informed of the tentative dates for scheduling for a specific proposal, that these dates be reasonably firm with a low probability of being delayed for more than a few weeks. These scheduling aspects are important for the observers because the observers will need to arrange their activity schedules to accommodate extended visits to Green Bank.Such arrangements are often difficult to make, particularly during the academic year, and it is important to avoid needless effort and frustration that result from delays that occur for the sole reason of being overeager in calling for proposals.

REPLIES TO QUESTIONS FROM NRAO:

1.) Commissioning. Observations by outside users must begin quickly both because early science results are important for the telescope and because operation of outsider programs will help ``shake down'' GBT systems.The current plan is to solicit proposals from black-belt observers oriented towards quick scientific results and exercising the various technical capabilities of the telescope and its associated equipment.The accepted proposals would be small in number and would be shared-risk proposals requiring the observer to reside in Green Bank for relatively extended periods of a couple of weeks or so.This plan a good compromise between full-time commissioning and full-time observing.

2.) Gemini proposal submission tool.The users committee is comfortable with the use of a Java-based form, similar to the Gemini Phase I Tool, for the submission of GBT proposals.It is important that such a system must

be very robust, easily installed, and functional on several computing platforms. Since it can be difficult to compose in them, there should be a way to include a file of text or at least cut and paste into the appropriate window.It should be fully tested before it is made public.

3.) GBT Receivers.We discussed at some length priorities in receiver development.The long-term goals of the Observatory should be (1) continuous coverage of all accessible frequencies and (2) development of array receivers, not an area of traditional NRAO expertise. These long-term goals should be pursued in parallel.

For single-frequency receivers, we agreed that last year's priority list still applies.To reiterate, in order of priority we recommend:

1. 68-95 GHz (W-band Module 1). This is important for the development of 3-mm capability of the GBT. With no receiver there would be a tendency for the laser metrology group, and the observatory as a whole, to relax on this development. This must not happen.

2. 26-40 GHz (Ka band). Spectral lines in this band have not been explored very well, partly because this band was a stretch for the 140-foot telescope. This is also a prime band for highly redshifted CO, which is very high-profile science.

For imaging receivers, we again agreed with last year's report, as modified by current developments. Specifically:

1.We STRONGLY endorse the development of the 1.4 GHz (L-band) phased array. We were SIGNIFICANTLY DISAPPOINTED to learn that the development of this array is currently planned to extend over the next several years. It is important for two reasons:
one, mapping capability at L-band is needed if the GBT is to make a significant contribution to observational astronomy at this wavelength;
two, if the development is successful the technology should be transferable to higher frequency systems, so this array should be constructed before significant development of imaging arrays at other frequencies is made.

2.20-26 GHz: This would be an array of horns, which is not new technology but is very important astrophysically.The NH3 molecule is perhaps the GBT's most valuable tracer of physical conditions in molecular clouds and, moreover, the GBT will work well in this frequency band early on.

3.We were happy to hear about the proposed very large array of 3-mm wavelength bolometers that might be developed in collaboration with other institutions. It is important for NRAO to be involved in this development so that it can reap the benefits when the first instruments are actually constructed. This said, however, the NRAO should not commit many resources in the near term because the GBT cannot work at mm-wavelengths until the laser metrology systems are fully functional. Some judgement on the part of NRAO administration is required to assess the proper balance.

UNSOLICITED COMMENTS:

a.) Telescope operators.We are glad that the GBT operators have been taking active roles in the telescope commissioning and, particularly, the all-important area of documentation.We urge that the documentation not be de-emphasized in favor of what might seem to be more pressing short-term needs.

More importantly, we were happy to learn that the concept of ``observing assistant'' will supplant that of ``telescope operator''.The plan is to have assistants who have taken courses and passed examinations in various areas of observational astronomy, and to reward their increased knowledge and capability with higher salary.This creation of a promotion path for operators means that NRAO is serious about involving these people in observations, and most particularly remote and queue-based observations.

b.) GBT correlator The GBT correlator will provide impressive spectral resolution, bandwidth, and simultaneous multiple line coverage.As such, it will be a good match to the wide bandwidths of the GBT receivers.

We are disappointed that some important observing modes, including cross-correlation and synchronous pulsar time-resolved spectra, have not yet been implemented.We urge that these capabilities be completed quickly.This requires software development, and there is currently no programmer for which this is a prime responsibility.It is important that this situation be corrected soon and the GBT correlator's full functionality be developed.

c.) GBT archive.The GBT should have a well-designed, smoothly-run data archive system.This is important both for the convenience of users and for future access to archival data.The observatory should develop a plan for public access to data, perhaps after an 18-month period, as at the VLA).GBT is a brand-new telescope, and in principle designing in an archive right from the start is an excellent idea.It is even conceivable that policies about required calibration during observing might be considered to ensure that the data are taken in such a way as to be usable later on--although such policies would have to be flexible, and not prevent observers from using novel and program-specific calibration schemes.

In practice, devising archival systems is difficult, especially given the wide variety of observing modes expected at the GBT.It is not realistic for NRAO to commit sufficient resources to developing a proper archiving system during the next year.Rather, this must be a long-term goal that is pursued in a measured, proper way so that archived data can be recovered in a consistent and reliable fashion.

d.) GBT front-end receiver turret.Last year it was reported that a relatively minor modification to the receiver room turret would allow switching between receivers without stowing the telescope.We are disappointed that any such plans have been put on a back burner.Fast switching between receivers will be crucial for spectral observations of time-variable sources.It also will increase telescope efficiency.

e.) Office space.Visiting observers have had difficulty getting sufficient office space at Green Bank.It is important that sufficient semi-private space, including both workstations and empty desks, be set aside for visitors. An additional item of importance is a cable connection so that observers can hook their laptops to NRAO's net.

f.) Software.We reiterate the importance of supplying a suite of software packages for data reduction at the GBT, as requested by the users.Some users have expressed a preference for other software packages in addition to or instead of aips++ to reduce their data; moreover, some will not be able to because their data reduction will require software capabilities that do not exist in AIPS++.Two packages of particular importance are IDL and CLASS because they are widely used in the astronomical community.

g.) Computers.Last year, we made the point that Green Bank's support of computers for visiting observers is quite weak and made some specific recommendations to address this problem.We were not presented with a plan at this year's meeting.Specifically, the GBT correlator will be operational on day one and require about 1MB per spectrum---so the problem is of ``freight train'' status!

h.) Green Bank Site.We were concerned and saddened to hear of the impending loss of contracts with the US Naval Observatory for VLBI monitoring and also VSOP/HALCA.This will apparently necessitate laying off some technical staff in Green Bank.In principle this has no direct impact on the GBT operations, but in practice a larger staff provides more expertise in different areas and the layoffs will not have a positive impact.

i.) Laser metrology.We were very pleased to see the high accuracy of the laser metrology measurements of the feed arm oscillations.The news that the intrinsic accuracy for measurements on non-horizontal paths might be as good as 10 microns -- ten times better than for measurements that are on horizontal paths close to the ground---is indeed very good.

The laser metrology system is important for GBT pointing, surface correction, and feed arm motion.These aspects take on increased importance at the high frequencies and we enthusiastically recommend that their development continue with full vigor.

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AIPS

The Committee notes the continuing heavy reliance on AIPS by the community, even following the initial public release of aips++.Strong support for AIPS must remain for the foreseeable future, even beyond the transition period from AIPS to aips++.By now many people have written tasks in AIPS. It will be a major job to learn how to port these tasks to AIPS++, because of AIPS++ admittedly steep learning curve.

The Committee strongly endorses certain goals:

1.) Continued support for NRAO instruments, in the form of bug fixes
and support for new observing capabilities, and
2.) a sufficient staffing level.

A simplified installation procedure for 31DEC99 would be appreciated, but
the Committee does not believe that limited NRAO resources should be
invested in producing a CD version of 31DEC99.One or more overseas mirror
sites may be useful to reduce demand from overnight jobs on the CV network.
Continued work on easing the complexity of data reduction for VLBA via
scripts is desirable for attracting and retaining new users of that
facility.

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AIPS++

The Committee applauds the progress of aips++, including the two public
releases, in the past year and the increasing usage by NRAO staff
themselves.The Committee is also encouraged by the efforts to introduce
the community to aips++, including the sessions at the NRAO Interferometry
Summer School and outreach efforts at AAS meetings and similar fora.

However, we are also aware that the package still contains many bugs and
this makes it very difficult to use. Fixing these bugs is very important
because people trying aips++ will be discouraged by them and will be
reluctant to continue acting as guinea pigs.

The Committee recommends continuing and increased efforts to introduce what
is clearly a powerful software package to the community.Additional
"training sessions" around the US, both at AAS meetings and universities,
are encouraged.Regarding new capabilities, the Committee recommends that
the aips++ group's two highest priorities should be

* End-to-end processing for VLA data (the so-called "thick path")
allowing a user to take data from any VLA observing program and
edit, calibrate, and image it within aips++. This is extremely
important and long overdue -- we note that the project has a long
history of missed functionality targets. This has been expensive
for radio astronomy, robbing other critical packages of vitality
because aips++ is constantly portrayed as imminently replacing them.

* Active involvement in the commissioning phase of the GBT with
respect to verifying and debugging dish's capabilities. While we
understand that dish has been more widely tested than some other
aspects of aips++, reactions from users have not been uniformly
positive.As dish may be essential for the rapid demonstration of
the power and success of the GBT to both the astronomical community
and the tax-paying public, we suggest that it might be valuable to
have the aips++ dish expert present at Green Bank for the first few
months of commissioning.

Establishing capabilities to analyze VLBA data within aips++ should be the next priority. The Committee rates these capabilities of higher priority than a port of aips++ to Windows NT.

With reference to specific questions posed by the aips++ group:

- Do they have any direct experience of running AIPS++? If so, what general comments do they have?

Committee experience varied.One member had used aips++ for imaging, while others had experimented with it.All had difficulty resolving conflicts with libraries.In some cases these conflicts were substantial---aips++ could not have been installed without un-installing libraries used for other essential applications.Those that had used it found it powerful, but with a steep learning curve.Continued outreach to the community and attention to providing a robust application across a wide range of environments will be essential.Also, expanded documentation, particularly documentation written by astronomers as opposed to computer scientists, will be necessary.

- Which platforms should we support with the release? Currently we do Linux (RedHat 6.* and SuSE 6.*), and Solaris 2.5, 2.6. Is Windows NT important?

The current set of platforms is sufficient.Higher attention should be given to expanding "basic" capabilities and to ensuring a robust distribution capable of working in the variety of environments (e.g., different libraries) within the supported architectures; little attention at this point should be devoted to expanding the suite of architectures supported.

- Is the current strategy of 6 month releases plus patches acceptable?

Yes.

- How important is development by non-consortium members? Do they know of anyone wishing to write complex applications in AIPS++?

The Committee knows of no-one familiar enough with aips++ to wish to expand its capabilities.

- Is our documentation useful? Should we continue with the newsletter?

The newsletter is helpful.The more that the documentation is written by astronomers, the better.

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Data Management

Regarding existing data management capabilities, the Committee lauds the scientific productivity of the VLA archive.However, the Committee is

concerned that insufficient attention has been given to designing and producing a similar archive for the GBT.The first priority of the Green Bank staff in the coming year should, of course, be commissioning the telescope; however, the archive is an important long-term project.

The Committee finds the concept of an Observatory-wide, beginning-to-end data management concept attractive.However, given limited resources, the Committee is concerned that sufficient attention has not been given to establishing priorities and achievable short-term goals.

With reference to specific questions posed by the Data Management group:

Rank the importance of the following:
1 Improve proposal submission
2 Improve archive content and accessibility
3 Streamline data analysis via automated reduction scripts
4 Improve telescope scheduling tools

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CDL

We are impressed with the organization and planning exhibited by the CDL. Producing the number of amplifiers and mixers required by GBT, ALMA and EVLA projects will be a formidable challenge.However, the requisite planning for scaling up the rate of device production to that required to support these projects seems well in hand.With the addition of the building expansion and additional testing equipment, the CDL seems well poised to carry out this formidable task.

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Spectrum management:

The electromagnetic environment is steadily becoming more complex and more hostile to passive services like radio astronomy.Both internally and externally generated interference steadily provide the spectrum manager with new problems.We were glad to learn of the Observatory's involvement in two projects for development of custom chips for interference excision, one with the SETI Institute, the other with the U. of Colorado.We heard nothing of the suggestion that we made last year: that all sites adopt the policy of the GBT project of testing all instrumentation in an anechoic chamber to insure that internally generated interference does not proliferate.However, with the currents years' budget, this is not surprising.

A special problem for the Observatory -- and for the US radio astronomy community as a whole -- is the retirement of Dick Thompson.This occurred

at a particularly unfortunate time when other staff members are being overloaded with GBT, ALMA and EVLA responsibilities.Effectiveness in the complex national and international radio frequency management community requires a senior and well respected member of the community to lead the efforts.We hope that the observatory can find another senior staff member to take on this role.The Users Committee stands ready to help out in issues in which the sheer numbers of stake-holders matters, but we are convinced that this cannot substitute for a senior person leading a sustained effort.

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Education and Public Outreach (EPO)

The Committee was very impressed with the progress made on a number of fronts in EPO in the past year. The combination of an NRAO scientific staff member (Beasley) with time dedicated to EPO and financial support has resulted in some long-needed improvements in this area. We hope that these efforts will continue to be supported financially both from outside and from within NRAO. The Committee was particularly pleased with the following developments, each of which addressed areas of concern raised in last year's report:

-- A marked increase in the number of scientific and informational press releases.

-- The improvements to the NRAO web site, visually and in terms of ease of use.

-- The plans to provide a radio image archive, both of NRAO images and of images from the larger radio astronomy community.

A number of specific comments covering the topics in italics follow.

1.) Education Officer for NM
The Committee strongly supports the hiring of an Education Officer at the New Mexico site, and feels that such a position could soon generate money for education and outreach efforts by way of grants (e.g. proposed VLA visitor's center, outreach materials). We hope that the model of success at Green Bank in this respect will be transferred to the VLA/VLBA site.

2.) Educational and Outreach Materials
In general, NRAO should do whatever it can to increase the visibility of radio astronomy and radio techniques in both the K-12 and undergraduate environments. The Committee supports the development of an undergraduate "course pack" in radio astronomy, though some members expressed concern that such an effort (and EPO efforts in general) take away from the support of

the NRAO telescopes and users. Members of the Committee also noticed that recent promotional materials from the Observatory have a more contemporary look, and were pleased to learn that a graphic design company would continue to modify the look of NRAO publicity materials.

NRAO might consider developing a series of "white papers" on "Radio Astronomy and _____". If NRAO were to develop a simple template, authors from the radio community could write the text (for a one page document at the high school level). The documents could be posted on-line in PDF format for teachers to download and print documents for distribution to their classes. Asking scientists to write in their area of expertise would reduce the text generating load at NRAO, and the contributions could be edited (see Education Officer above) and formatted by NRAO to present a unified look.Eventually, these "white papers" could be a valuable resource describing topics like "Radio Astronomy and the Sun" or "Radio Astronomy and the Milky Way". Optionally, a brief biography of the document's author (with photograph) could be included in order to personalize the explanation.

3.) Efforts in K-12 Outreach and Education
Planetaria and science museums are perhaps the best places to get the largest number of visitors who are interested in astronomy. For example, since the opening of Hayden Planetarium in New York (last February) over one million people have visited.Similarly, Adler planetarium had a very large number of visitors since the HST traveling exhibit and major renovations began. The Committee suggests that NRAO actively contact the directors of large planetaria and science museums and see what NRAO can offer to these institutions by way of information and images. We also suggest that NRAO investigate the possibility of developing a traveling exhibit on radio astronomy including VLA images and an interferometry primer (similar to the Hubble Space Telescope traveling exhibit).

4.) REU and RET
The REU and RET programs continue to be a great EPO successes.NRAO could perhaps do more to advertise these opportunities for teachers and students. NRAO might write up a few biographical profiles of former summer students (who are now radio astronomers at various universities) and have the profiles accessible on-line. RET opportunities for high school and college-level instructors should also be better advertised.

5.) NRAO Web Site
The Committee suggests that the NRAO web site add one additional "layer" which would serve to split incoming traffic into "scientific users" and "the public". An example of such a split is the Arecibo Observatory home page (www.naic.edu).Note that some sections of their web site,such as the summer student program, are accessible from both sides of the scientist/public split. The public area could be the location for press releases, popular-format (*.jpg) images, virtual tours, and the like, and the "scientific users" side could have a format similar to the one circulated at the meeting, written by Steve Myers.This prototype VLA page, at http://www.aoc.nrao.edu/~smeyers/VLAhome.shtml, is very well organized, and it makes a lot of information available quickly and easily. The science side would be the repository for all of the software, calibrator information, and other electronic "goods" that users need.

There is still a great need for an accessible, organized repository of VLA images, both for research and for general interest use. Current offerings for the public (e.g. http://www.aoc.nrao.edu/intro/image.index.html) have very sparse coverage and scant scientific content. For example, the link under Education marked "Radio Image Gallery" has pages last updated in 1997 (http://orangutan.cv.nrao.edu/nraonew.html) and contains mostly images of telescopes, and the astronomy images in that directory have no scientific explanation. Furthermore, it is not clear that a person interested in finding radio images would have even gone to the Education link.

6.) Various issues of concern:

a. Some users have found that the graphics-intensive web pages are slow to download, and worry about access to users without fast internet connections.

b. There was discussion of the need for updated, more concise documentation for using AIPS and AIPS++. In particular, a simple guide to VLA data reduction using AIPS at the level currently being written for VLBA data by Jim Ulvestaad would be useful for both undergraduate and graduate level students.

c. The Committee shares the concern expressed by T. Beasley that the numbers of graduate students employed as "pre-docs" at NRAO facilities has declined, but feel that this is unfortunately a symptom of a much larger issue (declining enrollments in graduate programs), and not anything that NRAO can necessarily rectify. Perhaps NRAO could try to more actively advertise the pre-doctoral positions, or even make them available competitively (in order to increase their visibility).

d. While there was a short discussion of whether the topic of EPO was outside the scope of the Users Committee Meeting, most of the committee members agreed that it is important to hear each year the status of EPO within the NRAO.

e. While the conference on "Gas and Galaxy Evolution" chosen to celebrate the 20th anniversary of the VLA was in many ways a success, it did not generate much publicity for NRAO, perhaps in part because it focussed on a specific topic. The broad range in topics discussed for the official 10th anniversary of the HST is part of what garnered such tremendous coverage from the New York Times and other news organizations.There may be a greater opportunity for positive publicity for NRAO with the upcoming 25th anniversary, if there is a more generalized symposium covering a wide range of topics.

f. We discourge the use of letter designations for frequency bands, and encourage the use of wavelength or frequencies, in order to make radio astronomy more user friendly.

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University Involvement

Many more people from more diverse backgrounds are making use of NRAO radio facilities than was true 30 years ago.While this multi-wavelength approach should be encouraged and supported because it is producing good science, a balance must be struck to insure that a new generation is trained in the detailed knowledge of radio astronomy required to plan and build new instruments and facilities.

The Users Committee encourages NRAO to continue to maintain strong ties to the university community to promote the health of the radio users community in the U.S.This may be especially important for the millimeter wave community because of the loss of the 12m telescope.Most important to consider are the smaller groups which do not have access to private telescopes.They depend on NRAO facilities in order to carry on their research.If this sector is not supported now, it will decrease the significance of the US users community of ALMA in the future.For the U.S. to compete successfully in an international enterprise, the infrastructure must be adequately supported.

The Committee suggests a number of possible actions:

1.) Involvement of the university community at more substantial levels in all the NRAO projects.
2.) Increased support for students to use NRAO facilities through fellowship programs or living expenses.
3.) Support for independent researchers to spend their sabbatical times at NRAO facilities.
4.) Provide greater support for the community especially in areas where there is the perception that things are too difficult, e.g. VLBA, AIPS++.
5.) Outreach programs not only for the general public, but also for the radio community and all of astronomy.This wouldultimately be important for the health of US radio astronomy.

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User Meeting Issues

We request a permanent NRAO web page for the Annual Users Meetings with very visible links, to enhance user community representation in the User Meetings. User committee members should be identified.One person (the chair?) should agree to receive email messages about NRAO user issues.The annual User Committee Reports should be posted on the site.

The length of the meeting seemed about right, with 1.5 days for presentations and discussions. Executive session of ~30 minutes at the start of the meeting, possibly during lunch, about 1 hour at the end of the 1st day, and ~2-3 hours the afternoon of the 2nd day to discuss the main points of our preliminary report.

In contrast to last year's meeting, it was clear that the NRAO staff were well aware of the previous year's User Committee Report.We were pleased

that the NRAO presenters devoted sufficient portions of their presentations responding to relevant items from the previous year's report.We request that this continue in future meetings.

Jeff Kenney, Chair
Yale University

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2000 NRAO USERS COMMITTEE MEMBERS

attendees:

Rachel Akeson<rla@ipac.caltech.edu>
David Boboltz<dboboltz@usno.navy.mil>
Steve Charnley<charnley@dusty.arc.nasa.gov>
Jason Glenn<jg@astro.caltech.edu>
Carl Heiles<cheiles@astron.berkeley.edu>
Paul Ho<pho@cfa.harvard.edu>
Jeff Kenney (Chair)<kenney@astro.yale.edu>
Joseph Lazio<lazio@rsd.nrl.navy.mil>
Colin Lonsdale<cjl@haystack.mit.edu>
David Nice<david@puppsr13.princeton.edu>
Pat Palmer<ppalmer@oskar.uchicago.edu>
Chris DePree<cdepree@ire.agnesscott.edu>
Tom Troland<troland@pa.uky.edu>
Steven White<white@astro.umd.edu>
Eric Wilcots<ewilcots@astro.wisc.edu>
Chris Wilson<wilson@physun.physics.mcmaster.ca>
Farhad Yusef-Zadeh<zadeh@oort.astro.nwu.edu>

others:

Todd Clancy<clancyr@colorado.edu>
Imke de Pater<imke@floris.berkeley.edu>
Lincoln Greenhill<greenhill@cfa.harvard.edu>
Elizabeth Lada<lada@astro.ufl.edu>
Chris O'Dea<odea@stsci.edu>
Bob Rood<rtr@virginia.edu>
Evan Skillman<skillman@ast1.spa.umn.edu>