NRAO NEWSLETTER

1 January 1994 No. 58

GREEN BANK

GBT NEWS

In the past few weeks several milestones were reached in the GBT project.

The final design of the tipping structure has been received and approved by NRAO. This design was among the most challenging aspects of the GBT project because of the unique offset geometry of the telescope's reflector, its large size, and the high degree of surface accuracy required. The difficulty in producing a satisfactory design has been responsible for all project delays to date. With receipt and approval of a final design, the fabrication and erection can go ahead at full speed with no future delays expected. The target date for completion of construction remains late 1995.

A significant milestone in the erection of the telescope occurred on December 20, when the alidade structure was rotated 180 degrees in azimuth using one of the four actual servo cabinets and two 30 horsepower motors along with their gear boxes, brakes, and tachometers. The accompanying photographs show the structure on the date of the move. Erection of the western part of the alidade, that accessable to the large derrick, had reached level 6, but the eastern part could not proceed beyond level 4 because of the limited height of the mobile crane and the limited reach of the derrick. From now on, the structure will be rotated as needed to bring it within reach of the derrick and erection will alternate between one side and the other.

As a prelude to the move, the alidade cable wrap was installed, power lines were run through it, a transformer was moved onto the structure, and it was all joined to the site feeder line. Installation of other electric wiring and equipment will proceed throughout the winter. The alidade up to level 7 (the elevation bearing support weldment) is scheduled for completion by mid-February.

The GBT Advisory Committee met in October to review the entire project. A high point of the review was the demonstration of the GBT monitor and control software on the 140 Foot Telescope. The software was used to point and track the telescope and control the spectral processor. It is planned to make the GBT software a permanent feature of the 140 Foot control system so that observers will be able to exercise and debug it before it is installed on the GBT. By early summer we hope to support certain types of 140 Foot observations using only the GBT software.

The 140 Foot will also be used as a testbed for the GBT laser pointing system. The laser system has been developed as far as is possible in the lab or by using static targets in the field. By installing retroreflectors and lasers around the 140 Foot, the motions of a real telescope can be monitored and pointing positions derived from the laser ranging can be compared with the actual pointing of the telescope under realistic observing conditions.

Dave Hogg has agreed to take over as GBT Pointing Coordinator. He will insure the interaction between team members working on details of the hardware and those working on the control system software. Of particular importance is the processing and assimilation of the various pointing corrections which will be transmitted, evaluated, and acted upon by monitor and control. Dave will be working directly with the pointing team which consists of representatives from monitor and control and the laser ranging group.

The spectrometer development suffered a setback when the first batch of chips that were successfully fabricated did not perform at the expected clock speed of > 100 MHz. The situation is under review, and we hope to understand the nature of the problem, and possible solutions, in the next two months.

Construction of the first set of GBT receivers is well under way. The 18-22 GHz, 22-26.5 GHz, 12-15.4 GHz, and 8-10 GHz receivers are complete and are being tested. The digital continuum receiver is in the final design stages. There will be an article describing it in the next Newsletter.

The configuration and priorities of the GBT receivers to be built in 1995 are being reviewed. Questions under discussion include the need for and properties of a tertiary reflector and the detailed design of the Q-band receivers/array. Summary information on GBT receivers is in Newsletter #53, and an update will appear in the next Newsletter. Anyone who wants further information or has comments on these developments should contact Roger Norrod or Jay Lockman (NRAO, Green Bank).

R. D. HALL AND F. J. LOCKMAN

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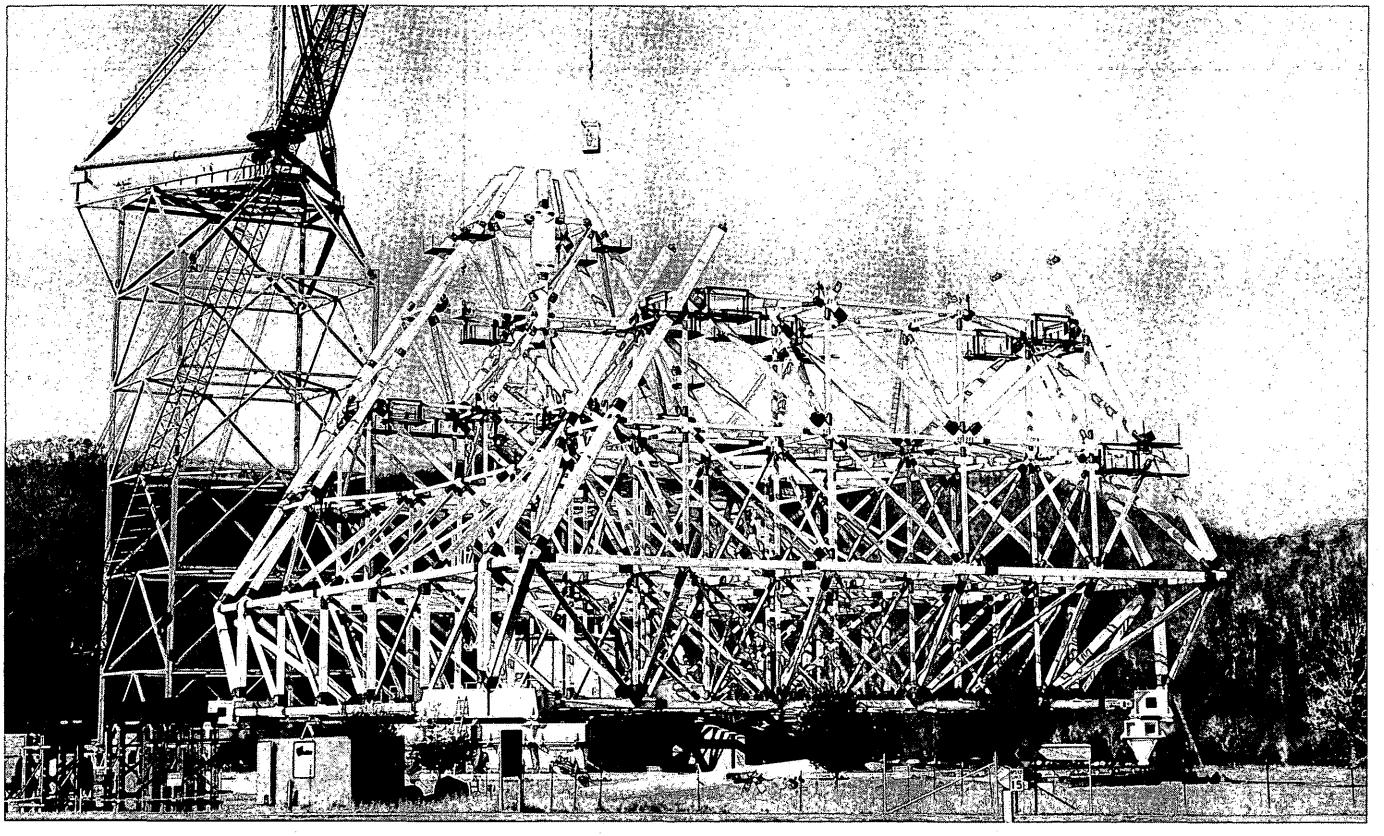
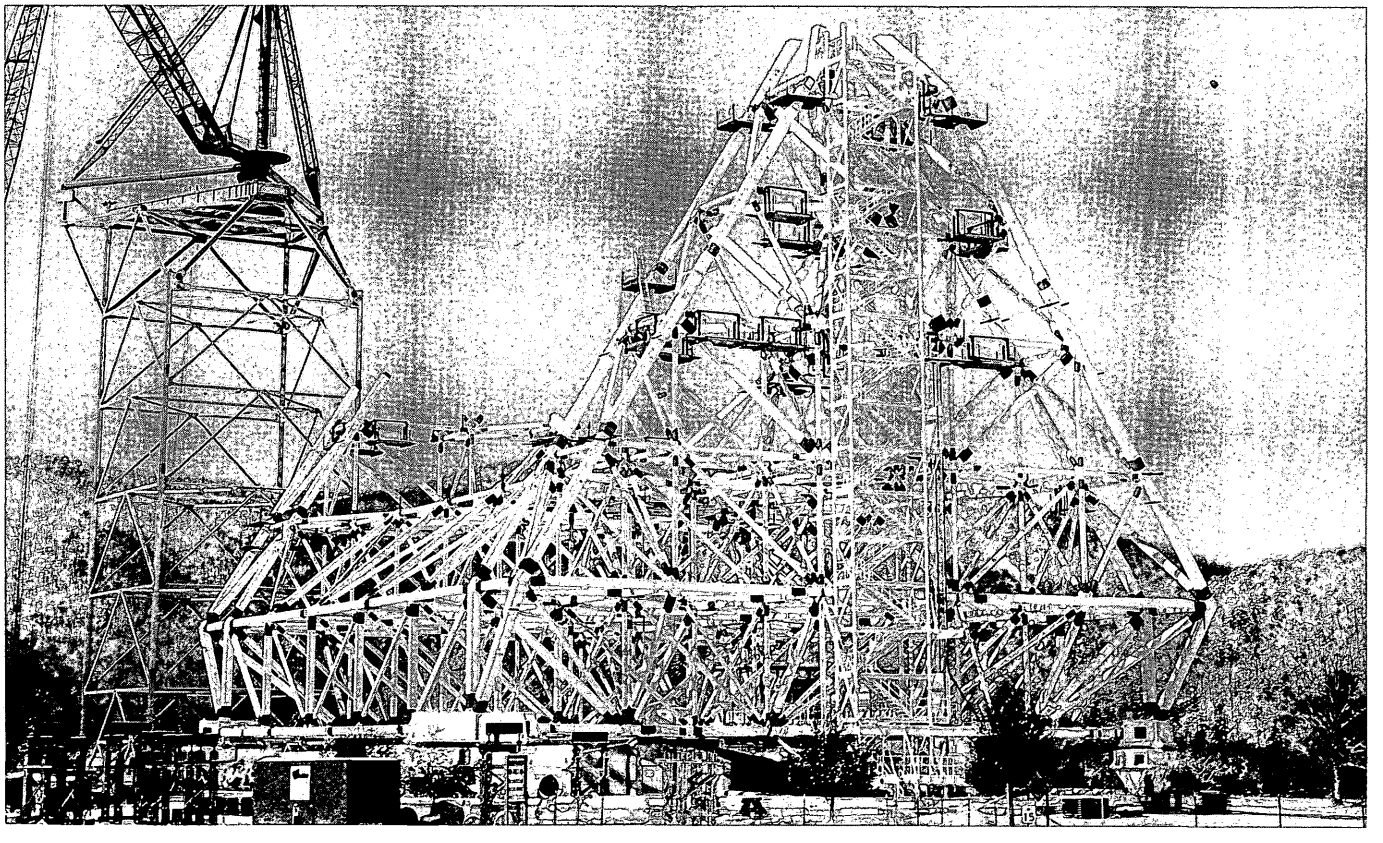




The GBT before (top) and after (bottom) its first rotation in azimuth.
The top of the structure is about 180' above the ground.

140 FOOT TELESCOPE BRAKE FAILURE

After 27 years of operation the center brake unit on the polar axis has failed for the first time. The telescope is now operating with the two outer polar brake assemblies, and some restrictions must be applied until the center brake is repaired.

When winds reach 45 miles per hour (gust or sustained) from any direction, observing will be terminated and the telescope will be stowed. The telescope is more vulnerable when positioned at large hour angles or extreme declinations.

Wind loading is more of a concern than buildup of snow and ice. During the winter months, observers may expect to have occasional degraded high frequency performance due to snow and ice buildup as we attempt to protect the telescope from high winds.

There may be some delay in returning to full operation immediately after holiday shutdown since the antenna will be parked at the stow position with the brakes set. Snow and ice buildup can be expected during those periods.

These restrictions should have a minimal effect on most observers, while giving the telescope a considerable margin of safety.

L. S. MACKNIK

TWO RETIREMENTS

Two Green Bank employees well-known to visiting observers have decided to retire this January.

Chuck Brockway, an engineer in the electronics division, has been responsible for the operation of all 140 Foot cassegrain receivers and optics for about 20 years. Chuck has continually improved the sensitivity and reliability of the masers and upconverters and developed the beam-splitter and its associated optics. In the past few years he has extended the frequency coverage of the telescope by building the 35 GHz system, and has replaced many of the upconverter receivers with HFET amplifiers for improved stability and performance. Every observer who has used the cassegrain receivers on the 140 Foot owes a debt to Chuck for keeping the 140 Foot equipped with state-of-the-art receivers. Chuck has also had a major role in the GBT project, developing the autocollimator pointing system. His outstanding work on frontends, optics, subreflector servo, and autocollimator systems will be greatly missed.

The other retiree is Bob Viers, former supervisor of the 300 Foot Telescope. Bob joined NRAO in 1959 and was in charge of the 300 Foot Telescope from the time the instrument went into operation until its collapse in 1988. Bob supervised the many improvements made to the telescope over the years, including installation of the travelling feed which allowed source tracking at the lower frequencies and upgrade of the reflector surface which allowed operation to 5 GHz. Bob helped the 300 Foot become the dependable instrument that it was, producing exciting science up to the last. Since 1988 Bob has worked on the GBT project in the engineering office.

We will miss Bob and Chuck and wish them well in their retirement.

F. J. LOCKMAN

140 FOOT RECEIVERS

Because of Chuck Brockway's retirement, we are reviewing the entire cassegrain receiving system, which covers 5-35 GHz. Mike Masterman and an engineer who will be hired to replace Chuck will be sharing day-to-day responsibility for the receivers. We tentatively plan to replace the masers (which are now only used at K-band) with HFET amplifiers for improved stability and reliability. With the removal of the masers, we will no longer need the 4 Kelvin cryogenics system which should significantly improve the system reliability. We are considering other ways to reduce the maintenance required and to simplify receiver changeovers. Anyone who is interested in details of the plan, or who has comments, should contact Roger Norrod for more information.

F. J. LOCKMAN

REMOTE OBSERVING AT THE 140 FOOT

Observers occasionally wish to use the 140 Foot Telescope from their home institution rather than travel to Green Bank. We are happy to support this observing mode if possible, and there are several steps that observers can take to insure the success of such a session.

• Please contact us as soon as possible to describe your program and make sure that we are able to support it remotely. The current control system at the telescope makes it awkward to support remote observations for some experiments, like those that require frequent or on-the-fly modifications to observing files.

• Complete observing files should be received here at least 72 hours before the start of the observing. This allows us time to scrutinize them for errors and change them to conform to any modifications in the equipment or software.

• The observers must identify a contact person who will be available at all times during the experiment. It is possible to monitor the incoming data over the Internet, and the contact person should do so. We cannot guarantee correctness of data, although we will do everything possible to assist observers in determining if there are any problems.

• If it is necessary to experiment with various techniques or equipment setups, separate observing files should be submitted for each case. Observers should not rely on us to make significant changes to files during an experiment.

For 140 Foot experiments that use the Mk IV autocorrelation receiver, users should contact Ron Maddalena for help and contact Bob Vance (bvance@nrao.edu). Ron and Bob are also the appropriate contacts for questions about telescope control. Spectral processor users should contact either Mark Clark (mclark@nrao.edu) or Rick Fisher (rfisher@nrao.edu). These people will be able to assist you in preparing and submitting observing files over the network.

The most successful remote experiments seem to be routine ones, such as mapping or monitoring, which have been debugged during previous visits to the site. The control system of the 140 Foot Telescope is rather old and not conducive to creative observing from a distance.

F. J. LOCKMAN

VLBA/VLBI

VLBA STATUS

On October 21, the VLBA correlator passed the "First Science" milestone by producing two scientifically meaningful images from VLBA observations. The original First Science announcement is shown on the next page. This and color images are available via the mosaic information system (see the announcement by Richard Simon in this newsletter). The image of 3C 84 has been considerably improved since the announcement by further editing, calibrating, and imaging. The dynamic range is now approaching 5000, and the image reveals the presence of a counterjet not previously seen in any other observations.

Work on the correlator has concentrated upon passing a small number of projects through correlation and into AIPS. Both NRAO staff and some outside users (Mark Reid and colleagues from CFA) have participated in this testing. As expected, this revealed a number of problems in various areas, ranging from tape recording and playback quality to AIPS data analysis. Most of these problems can be and have been addressed promptly. The most serious limitation of the correlator is currently that for observations of some number of stations greater than 10, the correlator computer runs out of CPU time to calculate geometric models. The ultimate remedy to this type of limitation is to install a larger and more capacious computer in the correlator, and also to use multiprocessing on two CPU's. Both of these are being actively pursued. Meanwhile, even the current maximum throughput will allow correlation of many types of VLBA-only observations, which amounts to a significant number of tapes in the backlog. MkIII format tapes can now also be correlated, although some work is still required before the logs from non-VLBA stations can be used. For the next few months, testing and some production correlation will continue in tandem. A lot of work is still required before the correlator achieves a level of moderately efficient operation, but we do expect to start releasing some tapes from the backlog very soon.

Only a small amount of observing is being performed currently due to the extremely limited number of free tapes. This will improve as the correlator starts to process and release tapes in the backlog. In addition, the next procurement of thin tapes is expected to begin being placed into operation at the end of the first quarter of 1994.

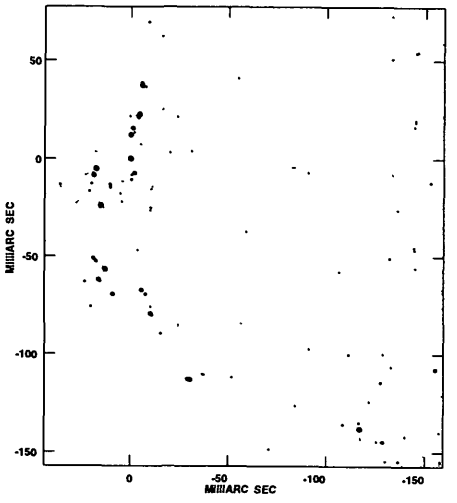
T. J. CORNWELL

First Scientific Results from the VLBA Correlator

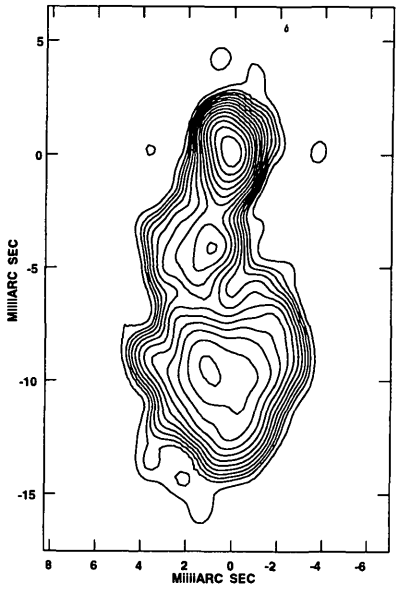
1993 October 21

First scientific results were obtained from the VLBA correlator during the preceding week. These represent as well the "last first" for the VLBA, the first end-to-end operation of the entire instrument. We are pleased to present below parallel first images indicative of two of the VLBA's primary capabilities, high-resolution spectroscopy and wideband continuum imaging. The data were correlated in a single pass (though not the first!) with a twofold speedup relative to observing time. Calibration and editing information were derived from standard VLBA monitoring procedures. All calibration and imaging operations were carried out using AIPS.

H_2O masers in W3(OH). Six VLBA stations (NL/FD/LA/PT/KP/BR) observed at 22.235 GHz for 12 hours on 1993/4/12–13, in a time-shared mode with net duty cycle 37.5%. Two 4-MHz channels in opposite hands of circular polarization were recorded, at two bits per sample. Maser components in the map, made from the RCP data only, cover about 120 of the 256 spectral points measured by the correlator. The dynamic range of about 100 is limited by the low-duty-cycle observing technique and by playback flaws. This image, generated by P. J. Diamond, agrees closely with one reported by Alcolea *et al.* (Conference on Astrophysical Masers, Arlington, Va., 1992).



The Nucleus of 3C84. Eight VLBA stations (HN/NL/FD/LA/PT/KP/BR/MK) observed at 8.414 GHz, for 14 continuous hours on 1993/8/18. Two 8-MHz channels in opposite hands of circular polarization were recorded, at one bit per sample. The correlator's effective spectral resolution was 16 spectral points per band. Both bands were calibrated independently, and then combined. Dynamic range criteria are peak:rms $\sim$ 1200; integrated:rms $\sim$ 10000. This image was generated by R. C. Walker, and agrees well with unpublished results obtained by Romney, Alef, and Kellermann at 10.7 GHz.



The VLBA correlator has been under development for nearly eight years. During that time, the following NRAO personnel — listed, in each group, in order of joining the project – contributed substantially to its design, construction, and commissioning.

Engineers: R. P. Escoffier, C. M. Broadwell, J. H. Greenberg, M. E. Runion; Technicians: W. A. Brown, R. R. Treacy;
Programmers: J. M. Benson, D. C. Wells, J. E. Horstkotte, R. D. González, S. J. Blachman, R. W. Heald, B. E. Rowen;
Operators: K. R. Hartley, J. B. Lewis, S. M. Thompson, S. C. Cook

Project Leader: J. D. Romney.

zia:~ftp/pub/vlbacorr/isci.cn.ps

PROPOSING TO USE THE VLBA

Proposals requesting use of the VLBA either during or outside of VLBI Network sessions are welcome. Proposal deadlines are February 1, June 1, and October 1. Upcoming VLBI Network sessions are described elsewhere in this Newsletter. Observing periods for non-Network VLBA projects are identical to those for the VLA discussed elsewhere in this Newsletter.

Anonymous-guest ftp can be used to access VLBA information files in directory "pub" on host "ftp.aoc.nrao.edu" [146.88.1.4]. Of prime interest to proposers are files "prop.vlba," giving details of the VLBA proposing process, and "obssum.vlba.ps," the VLBA Observational Status Summary, updated in June 1993 and available now as a PostScript file or a LaTex document. This update was paper-mailed to those on the VLA/VLBA master address list.

Successful proposers should be aware that the VLBI scheduling program SCHED, plus its related files, also are available via anonymous-guest ftp on "ftp.aoc.nrao.edu" [146.88.1.4] in directory /u/ftp/pub/sched.

J. M. WROBEL AND R. C. WALKER

VLBI NETWORK CALL FOR PROPOSALS

Proposals for VLBI network observing are handled by the NRAO. In particular, the network sessions for 1993 and 1994 are expected to be as follows:

Session	Dates	Bands	Proposal Deadline
1	16 Feb to 09 Mar	1.3, 6, 18	1 Oct 1993
2	13 May to 03 Jun	3.6/13, 6, other	1 Feb 1994
3	14 Sep to 05 Oct	1.3, 3.6/13, 6	1 Jun 1994
4	02 Nov to 23 Nov	0.7, 3.6/13, 18	1 Jun 1994

The Caltech Mark II processor will end routine correlation for the astronomical community at the end of 1993. In order to have an orderly shutdown of this facility, no further proposals for Mark II observations will be scheduled without assurances from the manager of a Mark II correlator that the observations can be processed.

It is recommended that proposers use a standard cover sheet for their VLBI proposals. Fill-in-the-blanks ASCII forms and fill-in-the blanks TeX files (for those who have TeX support on their home computers) are available by anonymous ftp from ftp.aoc.nrao.edu, directory pub/vlbicover, or from ftp.cv.nrao.edu, directory proposal. They are also available through the "mosaic" wide-area information service. A new version of the cover sheet was installed on September 9, 1993, including a new version of the EVN logo, evn.ps. Printed forms, for filling in by typewriter, are available on request from Joanne Nance, NRAO, Charlottesville.

Any proposal requesting antennas from two or more institutions in the European VLBI network constitutes a global proposal. Global proposals MUST reach BOTH networks' schedulers on or before the proposal deadline date; allow sufficient time for mailing. In general, fax submissions of global proposals will not be accepted. For global proposals, or those to the EVN alone, send proposals to:

R. Schwartz
Max Planck Institut für Radioastronomie
Postfach 2024
53010 Bonn
Germany

(Note the recent address change.)

For proposals to the U.S. network, the VLBA only, or global network proposals, send proposals to:

Director
National Radio Astronomy Observatory
520 Edgemont Road
Charlottesville, VA 22903-2475
USA

B. G. CLARK

VLA CONFIGURATION SCHEDULE

Configuration	Starting date	Ending date	Proposal Deadline
D	29 Oct 1993	07 Feb 1994	1 Jun 1993
A	25 Feb 1994	02 May 1994	1 Oct 1993
BnA	13 May 1994	30 May 1994	1 Feb 1994
B	03 Jun 1994	06 Sep 1994	1 Feb 1994
CnB	16 Sep 1994	03 Oct 1994	1 Jun 1994
C	07 Oct 1994	12 Dec 1994	1 Jun 1994
DnC	16 Dec 1994	09 Jan 1995	1 Oct 1994

The VLA is currently scheduling two large surveys. One will be done at night in the DnC and D configurations (18^h-06^h and 00^h-10^h, respectively, for the 1993 D configuration) and one in the north galactic cap (07^h-17^h) in the B configuration. Observing time in those configurations and LSTs will be much reduced over past practice. On the other hand, observations disjoint with the surveys in those configurations will have more time available for scheduling than has previously been the case.

The maximum antenna separations for the four VLA configurations are: A-36 km, B-11 km, C-3 km, D-1 km. The BnA, CnB, and DnC configurations are the hybrid configurations with the long north arm which produce a round beam for southern sources (south of about -15 degrees declination).

Approximate Long-Term Schedule

	Q1	Q2	Q3	Q4
1994	D,A	A,B	B	C
1995	D	D,A	A,B	B
1996	C	D	D,A	A,B
1997	B	C	D	D,A
1998	A,B	B	C	D

Observers should note that some types of observations are significantly more difficult in daytime than at nighttime. These include observations at 327 MHz (solar and other interference; disturbed ionosphere, especially at dawn), line observations at 18 and 21 cm (solar interference), polarization measurements at L-band (uncertainty in ionospheric rotation measure), and observations at 2 cm and shorter wavelengths in B and A configurations (tropospheric phase variations, especially in summer). They should defer such observations for a configuration cycle to avoid such problems. The B configuration daytime will be about 08^h RA and the C configuration daytime will be about 15^h RA.

Time will be allocated for the VLBA on intervals approximately corresponding to the VLA configurations from those proposals in hand at the corresponding VLA proposal deadline.

B. G. CLARK

NRAO GUEST HOUSE

Construction of the project started in August 1993 and is on schedule. The building is expected to be completed in mid-February, 1994. The accommodations include eight single rooms, four double rooms, two 2-bedroom apartments, a common room, kitchen, and laundry room.

T. ROMERO

COMPUTING AT NRAO-NM

In keeping with Internet styles, we recently created an alias to use when obtaining files from the AOC through anonymous ftp. This alias is independent of any particular system. Using it means that if we should change the location of our anonymous ftp area in the future, the change will be transparent to you. Otherwise, if the ftp files move, there is a chance you could lose access to the service until you learn the name of the new ftp host. Instead of the full name zia.aoc.nrao.edu, please use the alias "ftp.aoc.nrao.edu." Similarly, to get to our online information system through mosaic, please use the alias "http://info.aoc.nrao.edu/."

Consistent with plans announced in past issues of the NRAO Newsletter, on 15 March 1994, the AOC will see the end of an era: Yucca, the last NRAO Convex C-1, will be shut down permanently. With the advent of our new workstations, this system is no longer cost-effective to run as it provides only slightly more CPU power for most jobs than the average desktop system, at a much higher operating cost. The Mark II correlator was the last key equipment supported on Yucca, and it already has been turned off.

The greatest effect of this shutdown is on support of AIPS for Convexes. Such support has been minimal for the past year in any case, but once our last Convex is gone, NRAO will only be able to support Convex AIPS through contact with other sites. More information on this subject will be provided in the next issue of the AIPS newsletter.

Effective December 1, 1993, Gustaaf van Moorsel became head of the VLA/VLBA Computing Division, with overall responsibility for Division services. Ruth Milner is now manager of Computing Systems and will oversee the areas of systems/user support, operations, and maintenance.

R. MILNER

ASSISTANCE FOR VISITORS TO THE AOC

Assistance from the AOC staff will be provided as needed and as requested on the Observing Application cover sheet.

Staff Contact - For frequent visitors and/or experts who do not need technical assistance, the staff contact will provide a brief update on new procedures, hardware, and software at the AOC since the last visit.

Friend - For inexperienced users who are new to synthesis imaging and infrequent visitors whose experience is out of date who may require more than just an occasional consultation on technical matters relating to observing and data analysis.

Collaborator - For VLA and VLBA users, both experienced and inexperienced, who anticipate the need for extensive staff interaction, the assistance of a staff collaborator who has common scientific interests is possible.

Students who are first time users of the VLA/VLBA and/or the AOC data reduction facilities are reminded that they must be accompanied by a senior researcher when they come to the AOC to prepare observations or to reduce data.

Providing adequate notice of your visit to the NRAO staff will ensure that all necessary arrangements are made for a successful visit. A one week notice is acceptable, but on such short notice the user may not get exclusive assignment of a workstation, staff contact, or friend.

Since the most intensive level of technical support is required at the beginning of an observing or data reduction run, it helps if visitors arrange to arrive on a weekday if possible. It is more difficult to arrange for staff assistance if arrival is on a weekend.

T. ROMERO

NRAO MEMORANDA

Current up-to-date indexes of all VLA/VLBA memos are available electronically. The listings are in the public area <vlais> under the GEN heading of the main menu. To access <vlais>: telnet to zia.aoc.nrao.edu, then logon with <vlais> in lower case. No password is necessary. Each listing will give a contact name, e-mail address, and phone number for requesting specific memos.

T. ROMERO

7 MM RECEIVERS FOR THE VLA

Three 7 mm receivers have been installed on the VLA since November 15, 1993. Two more are completed in the lab except for last minute adjustments to the low-noise amplifiers. At least one of these will go to the array before the end of 1993. The plan remains to have seven receivers installed by the beginning of the A-configuration in 1994 and nine receivers by June. The tenth receiver will be installed after the early receivers undergo some retrofits.

The zenith system temperature of the three receivers is about 100 K between 41 and 45 GHz, rising to 150 K at 40 GHz and 49 GHz. Measurements by Doug Wood show that zenith optical depth under good winter conditions ranges from 0.06 at 41 GHz to 0.15 at 50 GHz.

On December 5, 1993, Luis Rodriguez (UNAM and currently on sabbatical at NRAO) made the first VLA image at 7 mm wavelength. He observed MWC 349 for two hours using the three 7 mm antennas at 4 x 50 MHz bandwidth at 43 GHz. The observed rms noise, using one baseline and one IF channel over 10 seconds, was about 180 mJy. This translates to 0.7 mJy with all ten antennas, 4 x 50 MHz bandwidth, and one hour of integration.

R. A. SRAMEK

12 METER

1 MM RECEIVER UPGRADE

The 1 mm SIS receiver has been upgraded and expanded. It was re-installed on the telescope in mid-November and is working well. This receiver package provides complete tuning coverage from 200 to 300 GHz in two bands. The receivers are dual-polarization and use a quasi-optical image sideband suppression system.

The staff made the following enhancements to the receiver during the summer and fall:

- The 260-300 GHz mixer set was installed in the cryostat. One can switch between the 200-265 GHz and 260-300 GHz mixers in a few minutes.

- Independent local oscillators for the two polarizations have been installed. One can now observe at two different frequencies simultaneously, albeit in only one polarization each. The two frequencies must be within the tuning range of a given mixer set. For example, one could observe ^{13}CO (220 GHz) and ^{12}CO (230 GHz) simultaneously in the low frequency band, or HCN (266 GHz) and HCO^+ (268 GHz) simultaneously in the high frequency band. Note that this mode of observing is advantageous primarily to reduce telescope movement overhead losses or to achieve good cross calibration. Observations of weak signals from single lines are still best done with both polarizations tuned to the same frequency.

- A number of other technical enhancements were incorporated, including a new high-capacity refrigerator system, a new on-board computer system, and new X Windows-based receiver tuning software. Other enhancements, particularly concerning the quasi-optical single sideband system, will follow in the coming months.

P. R. JEWELL *(for the Tucson and CDL Receiver Groups)*

VLBI AT THE 12 METER TELESCOPE

This year we have had two successful mm-wave VLBI runs with the 12 Meter. For those runs, we used temporary cables laid over the ground between the 12 Meter and the nearby Kitt Peak VLBA antenna. The VLBA maser signal was sent over one cable to the 12 Meter to control all local oscillators, and the IF signal was returned to the VLBA building to be recorded on the standard VLBA recorder system. The 12 Meter participates in both 3 mm and 1 mm wavelength experiments.

We are in the process of making the link between the 12 Meter and the Kitt Peak VLBA antenna more durable, replacing the coax cable with armored fiber optic cable. We hope that future participation in mm-wave VLBI experiments will be much easier for the 12 Meter.

D. T. EMERSON AND P. R. JEWELL

ON-THE-FLY MAPPING

The 12 Meter Telescope is developing an on-the-fly (OTF) mapping capability for both continuum and spectral line observing. A basic system is available for use now. In OTF mapping, data are acquired continuously while the telescope is driven smoothly across the mapping field. This is more efficient than the traditional "grid" or "step and integrate" observing mode since the telescope servo system is not required to settle into each grid position before the integration is commenced. In the 12 Meter implementation, the actual telescope encoder positions are recorded every 10 ms and are associated and averaged for the corresponding parcel of data. Data samples are recorded every 125 ms in the continuum case and every 100 ms in the spectral line case. Typically, the data are oversampled in the scanning direction and critically sampled in the transverse direction. The data can be properly gridded in the analysis stage. Because the entire map field can be scanned rapidly, the data are less susceptible to weather and receiver gain drifts from point to point. Normally, it is necessary to cover the field many times to achieve the desired signal-to-noise. The map quality should be superior to the conventional mapping technique, however.

OTF observing routines are available now for continuum observing with the digital backend and for spectral line observing with the filter banks. OTF with the hybrid spectrometer should be available after next summer. Continuum OTF has been used by two observing groups so far. A number of procedures are available through the UniPops analysis system for first order data reduction. Through the help of Chris Salter (Arecibo), we expect to have a more elaborate and powerful continuum reduction package shortly. Spectral line OTF analysis is less advanced. A number of quick-look UniPops procedures are available for displaying a specific slice of a data cube. Bob Garwood is working on a more general reduction system for spectral line OTF that may be available in a few months.

Observers are welcome to experiment with either continuum or spectral line on-the-fly mapping and to provide us with comments and suggestions. We can provide assistance with the analysis while the techniques are being refined.

D. T. EMERSON AND P. R. JEWELL

IN GENERAL

NRAO TO PROVIDE ON-LINE DOCUMENTATION USING NCSA MOSAIC

The NRAO is now providing on-line documentation for Internet users. The NRAO is working towards making most kinds of routine documentation available to users on-line through the Internet, including facilities descriptions, proposal procedures, descriptions of major initiatives, and various NRAO memo series. This will provide users with the most up-to-date documentation possible whenever needed.

The recent development of Mosaic and the World Wide Web by the National Center for Supercomputing Applications (NCSA) and the European Center for Nuclear Research (CERN) provides a method for organizations like NRAO to make routine documentation available on line to interested users. Mosaic is a software system which provides a hypertext interface to PostScript documents, text files, images, and even audio clips. Mosaic relies on public domain viewers for these functions, such as ghostscript and ghostview for Postscript files and xv for images. A vast amount of information is readily accessible through Mosaic, ranging from documents from numerous astronomical institutions to art museum catalogs. These documents can reside at remote nodes on the Internet and are available transparently to a user running NCSA Mosaic software (for users unable to run Mosaic, most documents will be available from NRAO via anonymous ftp).

Implementations of Mosaic are currently available for free from NCSA for UNIX, Macintosh, and Microsoft Windows platforms. In order to allow NRAO users easy access to Mosaic, NRAO has prepared files containing pre-compiled executables and documentation for Mosaic for SunOS version 4.1.2 or 4.1.3 (from NCSA and public domain sources). Interested users may retrieve these versions of Mosaic directly from NRAO via anonymous ftp from ftp.aoc.nrao.edu (IP address 146.88.1.4) in the pub/doc directory. Users with other computing operating systems should acquire Mosaic directly from NCSA using ftp from ftp.ncsa.uiuc.edu.

NRAO intends to make a large variety of documentation available through Mosaic. Currently, NRAO has documentation available through Mosaic about its major facilities and instruments, important initiatives, instructions for the preparation and submission of proposals, and other general documentation. Recent significant accomplishments are also documented: for example, users may be interested in seeing the first scientific results from the VLBA correlator, including copies of high resolution images. Plans are underway to provide a variety of documentation for the GBT, the proposed Millimeter Array, the AIPS++ software project, and other initiatives.

The address for the NRAO home page is "http://info.aoc.nrao.edu/." From inside Mosaic, use the "open" command to connect directly to NRAO.

R. S. SIMON

AIPS++ PROJECT

The Astronomical Information Processing System (AIPS++) is a software system primarily for astronomical data analysis being developed by an international consortium of institutions mainly supporting radio telescope instrumentation. The members of this consortium are: ATNF, Australia; BIMA, USA; HIA/DRAO, Canada; NFRA, The Netherlands; NRAL, UK; TIFR/NCRA, India; and the NRAO.

We were pleased to be able to distribute the first library release of AIPS++ in October 1993. This release does not contain much that is of direct interest to astronomers, but does contain building blocks of interest to groups building C++ applications using n-dimensional arrays, tables, FITS, etc. Some compromises in the contents of the release were made: fewer examples of application programs were included with the release than originally hoped and perhaps less documentation providing an overview of the library was included than we would have liked. Our efforts seem to have been justified; by the end of the year, the library source code had been down-loaded by 132 external people. Other results of the release are that the libraries are in the best shape that they have ever been in and that the AIPS++ project better understands the steps we need to take for the next release. Readers interested in more information about the library release or interested in obtaining a copy can get it via anonymous ftp from "aips2.cv.nrao.edu" in directory /pub/aips++/RELEASED/libaips-3.

We have set ourselves some admittedly ambitious goals for further releases. Our main goal is to release a beta version of AIPS++ in December 1994, with the first formal release in March 1995.

On the way towards this goal, we are aiming for an internal milestone in March 1994 to be able to provide determined programmers at AIPS++ Consortium sites sufficient tools and examples that they can begin the first stages of application development (e.g., begin work on appropriate data fillers). Thus, this is a release of code which will enable our colleagues to make progress on aspects of AIPS++ which are specific to their own instruments.

The experience of the library release has been sufficiently valuable that we see the need for going through an improved version of the release process before our beta release in December 1994. We are therefore proposing that an internal alpha "friendly astronomer" release occur in June or July 1994. This will be the first test of the release process we want to develop, and should have enough in the code that (determined) astronomers can begin using the code we are developing for astronomical applications. Problems with the alpha release should be recognized in time that we will be able to make final decisions on how to proceed with the beta release.

The June/July release will consist of compiled tasks and some sort of user interface and documentation to "friendly astronomers" within the Consortium sites. This release will act as a means of communication with astronomers within Consortium institutions. Astronomers will be able to see what we are doing, and we will be able to garnish feedback from them concerning the tasks which need to be provided and the style of the user interface.

G. C. HUNT AND R. S. SIMON

RETIREMENT

Campbell Wade retired from the Observatory scientific staff at the end of 1993, after thirty-three years of service. His research includes early work on radio observations of HII regions, pioneering studies of radio stars and novae, and major contributions to fundamental coordinate systems and the positional aspects of radio astronomy. This latter interest motivated Cam's involvement in radio interferometry beginning with the Green Bank Interferometer and culminating in his efforts on the design of the VLA. Cam headed the team that selected the Plains of San Agustin as the VLA site. He participated in its construction, and he served as its director 1978-80. More recently he led the effort to site the VLBA antennas and the MMA. All of us who use NRAO telescopes owe Campbell a debt of gratitude, and we wish him the very best in his retirement.

P. A. VANDEN BOUT

OBSERVING PROPOSALS

In early December 1993 a notice regarding submission of observing proposals was mailed to subscribers of the NRAO Newsletter. This notice discusses policy changes, i.e., where to send proposals, deadlines and format, and instructions for submitting via e-mail. If you did not receive a copy of this notice, contact Joanne Nance (jnance@nrao.edu), (804) 296-0323.

J. L. NANCE

MILLIMETER ARRAY

For the last three months we have been working to understand the expected efficiency of phase calibration techniques and to understand the spectrum of atmospheric phase fluctuations over the three candidate MMA sites. These two questions are complementary views of one problem that come together in the site selection process. We would like to know what fraction of the time a particular site is useful for long baseline interferometry given a certain spectrum of atmospheric phase fluctuations and a technique for removing those fluctuations.

We have two measures of the atmospheric phase fluctuations on the candidate sites. First, the NRAO 225 GHz tipping radiometer periodically (usually every 5 hours) measured for one hour the variation of system temperature while pointed at the zenith. To first order the variation is a direct measurement of variation in the column of atmospheric water above the tipper. Since the atmospheric phase fluctuations are a direct result of variations in the column of atmospheric water vapor one can use the tipper measurements to infer the expected phase fluctuations. Such measurements have been made, and are being analyzed on all three sites. Complications involve the contribution of liquid atmospheric water (which contributes to T_{sys} but not phase) and the calibration between ΔT_{sys} and phase. The second technique relies on a comparison of the tipper measurements with the direct 12 GHz phase measurements from the SAO site-testing interferometer. Such a comparison can be made both on the candidate MMA site in the Magdalena Mountains and the CSO site on Mauna Kea. The preliminary analysis shows a surprisingly good correlation; the full analysis will appear as a numbered MMA memo.

Work in progress involves both the construction of a 12 GHz interferometer that we can use to interpret the tipper fluctuations on the sites of interest to the MMA and test observations on the VLA. With regard to the latter, D. Bagri has shown that while there is a nice correlation between 22 GHz T_{sys} and interferometer phase, the relative scaling between these two quantities can change by large factors on time scales of minutes. Test observations will be made throughout the winter on the VLA at 22 and 45 GHz to try to understand this phenomenon so that a technique applicable to the MMA can be developed.

The antenna design continues to be refined. J. Cheng is presently working to simplify the optical system and to compare the cost and weight of a conventional alt-az antenna with the slant-axis design where both antennas meet the same performance specifications.

At the suggestion of the MMA Advisory Committee, we have been studying the advantages of SIS sideband separating mixers relative to those of mixers in which the image is optically rejected. The goal is for the astronomer to be able to choose one sideband or another, or both, without allowing the unwanted sideband to contribute atmospheric noise. Preliminary analysis suggests that the latter offers better performance and ease of coupling the LO but does so at the expense of needing a cooled Martin-Puplett (M-P) interferometer. The cooled M-P will need to be prototyped before a final choice can be made.

R. L. BROWN

The following MMA memos were distributed in 1993. Copies may be obtained from Betty Trujillo in Socorro.

No.	Title	Author(s)	Date
95	Imaging With Known Pointing Errors	M. Holdaway	4/93
90 Rev.	Addendum #1 - A Study of Materials for a Broadband Millimeter-Wave Quasi-Optical Vacuum Window	Kerr/Bailey/ Boyd/Horner	4/93
96	Proposed Surface Error Budget for MMA Antenna	J. Lamb	5/93
97	Slanted-Axis Antenna Design I	J. Cheng	6/93
98	Geometry of the Slant-Axis Antenna	J. Lamb	7/93
99	Search for Possible Millimeter Array Sites on the U.S. Mainland	C. M. Wade	10/93
100	Temperature Measurements on BIMA 6-M Antennas-Part I: Backing Structure	Lamb/Forster	10/93
101	Slanted-Axis Antenna Design II	J. Cheng	10/93
102	A Possible Receiver Optics Layout for the MMA	J. Lamb	10/93
103	Some Fundamental and Practical Limits on Broadband Matching to Capacitive Devices, and Implications for SIS Mixer Design.	A. R. Kerr	10/93
104	Scientific Emphasis of Millimeter Array	R. L. Brown, *et al.*	10/93

NRAO USER SUPPORT

I would like to take this opportunity to remind you of some of the assistance that the NRAO provides its users and to encourage you to take advantage of it in those circumstances where it is beneficial to you. Since this information changes from time to time, we will keep an up-to-date summary in the NRAO mosaic file for your reference.

Page Charge Support. We encourage users of the NRAO telescopes and facilities to publish their scientific results in a timely manner. To this end the NRAO provides partial page charge support to scientists at U.S. educational and scientific institutions. The specific policy is summarized below.

1. When requested, NRAO will pay the larger of the following:

   (a) 50 percent of the page charges reporting original observations made with NRAO instrument(s) when at least one author is at a U.S. scientific or educational institution. Note that the 50 percent share restores this reimbursement to the level which had been provided to NRAO users for several decades.

   (b) 100 percent of the page charges prorated by the fraction of authors who are NRAO staff members.

2. In the future, page charge support will be provided for color plates. This change in policy obtains as a result of the more enlightened charges recently adopted by the journals for color reproduction.

3. To be eligible for page charge support authors must comply with all of the following requirements:

   (a) Include the NRAO footnote in the text: "Operated by Associated Universities, Inc., under cooperative agreement with the National Science Foundation."

   (b) Send four copies of the paper prior to publication to the NRAO librarian in Charlottesville.

   (c) Inform the librarian of the proposed date of publication and apportionment of page charges so that the necessary purchase orders may be initiated. Convenient ways to do this are to mail or fax (804 296-0278) a copy of the completed page charge form to the library or to simply send the librarian an e-mail message (library@nrao.edu).

Finally, the intent of the page charge support, clearly, is to help users in getting their observations into print. The radio observations should, therefore, make a substantive contribution to the paper if they are to receive support.

Travel Reimbursement. The NRAO provides partial travel reimbursement for users from U.S. institutions to conduct their observations and to reduce their data. Normally reimbursement will be approved for one traveler only per observing proposal and, separately, one traveler for a data reduction visit. Thus for a single scheduled observing proposal travel reimbursement may be approved for two visits to the NRAO, one to observe and one to reduce data. Exceptions to the "one traveler" rule are made at the site manager's discretion for observations of 24 hours or more in duration that require an observer's presence.

The "Request for Reimbursement" forms are available at all NRAO sites from the local site manager. Upon completion of the travel, the traveler should give the form to his/her travel office; that office will request reimbursement from the NRAO and payment will be made to the traveler's organization, not directly to the traveler. The Request for Reimbursement must be made within thirty days of the completion of travel and must be accompanied by the original air fare receipt.

Reimbursement is made for air fare only, and only then for flights originating within the United States or Puerto Rico with Charlottesville, VA; Tucson, AZ; or Albuquerque, NM as a destination. Reimbursement will not be made for lodging expenses or ground transportation.

Finally, only the cost of round-trip economy or discount air fare is eligible for reimbursement. As an encouragement for travelers to make reservations early and secure the lowest fares, we use a "cost-sharing" algorithm to determine the NRAO reimbursement. This is it: For air fare under $300 reimbursement will be made for the actual cost in excess of $150; for air fare in excess of $300 the reimbursement is $150 plus three-quarters of the air fare in excess of $300.

Travel to Foreign Radio Telescopes. The NRAO administers a modest fund for the NSF which supports the travel of astronomers at U.S. institutions who have proposals scheduled on foreign radio telescopes. Travel reimbursement is not available for travel to all foreign telescopes, but rather only to those that provide "unique" scientific capabilities.

Reimbursement is made for economy or discount air fare only up to a maximum of $1000. (Note, this represents an increase from the $700 maximum used in 1993.) Air travel must be on a U.S. carrier. One traveler only per observing proposal is eligible for reimbursement. Further information, a current definition of what constitutes a "unique" foreign telescope, and application forms may be obtained from Harvey Liszt (hliszt@nrao.edu; phone 804-296-0344).

R. L. BROWN

MAY 1994 WORKSHOP IN TUCSON

The NRAO will host a two-day workshop on "Multi-Feed Systems for Radio Telescopes" to be held on May 16 and 17, 1994, in Tucson, Arizona. The scope of the workshop is outlined below. There will be no conference fee, but participants will be responsible for the cost of their own travel, meals, and lodging.

Those wishing to make presentations at the Workshop are encouraged to submit an abstract of 100 words or less. These should be e-mailed, faxed, or mailed as soon as possible for preparation of the preliminary agenda in January.

D. T. EMERSON

Workshop on
MULTI-FEED SYSTEMS FOR RADIO TELESCOPES
Preliminary Announcement

May 16 & 17, 1994
Tucson, Arizona, USA

This Workshop is intended to cover sub-millimeter, millimeter-wave, and centimeter-wave telescopes, with both spectral line and continuum receivers. The following topics will be addressed:

- Description of existing and planned multi-beam systems
- Optical design considerations, image degradation, theoretical limits on number of feeds
- Compact feed design, compromises in feed performance
- Feed packing density
- Effects of, and minimization of, crosstalk between feeds
- Backend options
- Observing philosophies, mapping strategies, array tracking
- Beam differencing techniques
- Compensation of primary surface errors using complex image plane sampling
- Phased arrays as focal plane feeds
- Data analysis—optimization algorithms making use of the special spatial and temporal correlations present in multi-feed data
- Atmospheric cancellation using multi-beam systems
- Real-time visualization of multi-beam data
- Special considerations for multi-feed interferometer systems

The final versions of all papers, in camera-ready format, should be received in Tucson by April 30. TeX or Latex templates will be made available. Those interested in attending, please contact NRAO (preferably by e-mail). For general questions about the scope of the workshop, contact Darrel Emerson (Internet: **demerson@nrao.edu**). For reservations and general logistical information, contact Jennifer Neighbours (Internet: **jneighbo@nrao.edu**). Correspondence by mail should be directed to:

Darrel Emerson *or* Jennifer Neighbours
National Radio Astronomy Observatory
Campus Bldg. 65, 949 N. Cherry Avenue
Tucson, AZ 85721, USA
Fax — 602-882-7955

EDITOR NRAO NEWSLETTER
NATIONAL RADIO ASTRONOMY OBSERVATORY
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