



# NRAO NEWSLETTER

1 October 1995

No. 65

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## GREEN BANK

### GBT NEWS

Over the last quarter the visible construction activity has increased significantly at the Green Bank Telescope site. Current status is shown in the Figure on Page 2. There are fabrication and erection activities underway in several areas on the ground as well as high in the air on the structure. Since the installation of the elevation shaft, completed in May, the first section of the box structure (B1) has been installed and welded. The erection of the B1 box sequence supplied sufficient stiffness to the shaft to allow removal of the temporary support scaffolding. Also, all eleven of the elevation wheel sections have now been installed in place below the shaft. Alignment and welding of the wheel are approaching completion. All six of the large W19 beams which attach the el wheel to the shaft have been installed and aligned, and welding is underway.

On the ground, trial erection of the box segments B2, B3, and B4 is close to completion. These segments will eventually be taken apart in large modules to be lifted into their place in the structure. Also on the ground, assembly of the back-up structure (BUS) trusses has begun. Six sections are complete and standing on the assembly pad where the entire BUS will be assembled and aligned prior to being lifted to the structure in modules. A

seventh truss section is underway in the large assembly fixture. Many pieces of the feed arm structure have been fabricated and shipped to the site for storage until they are needed in the erection process.

The receiver room has been assembled and the feed turret, which will hold the Gregorian receivers and feeds, has been installed in the room. Interior finishing of the receiver room is underway. The actuator room has been outfitted with the equipment rack, the required unistrut, air conditioning, and wiring, and is ready for installation on the structure.

Approximately 800 of the total 2,000 panels have been manufactured and are stored at COMSAT/RSI's plant in Sterling, Virginia. Painting of the panels will begin soon. The subreflector back-up structure has been assembled and aligned at RSI. The subreflector panels are under production. Final alignment and testing of the completed subreflector is anticipated in November.

*W. H. Porter*

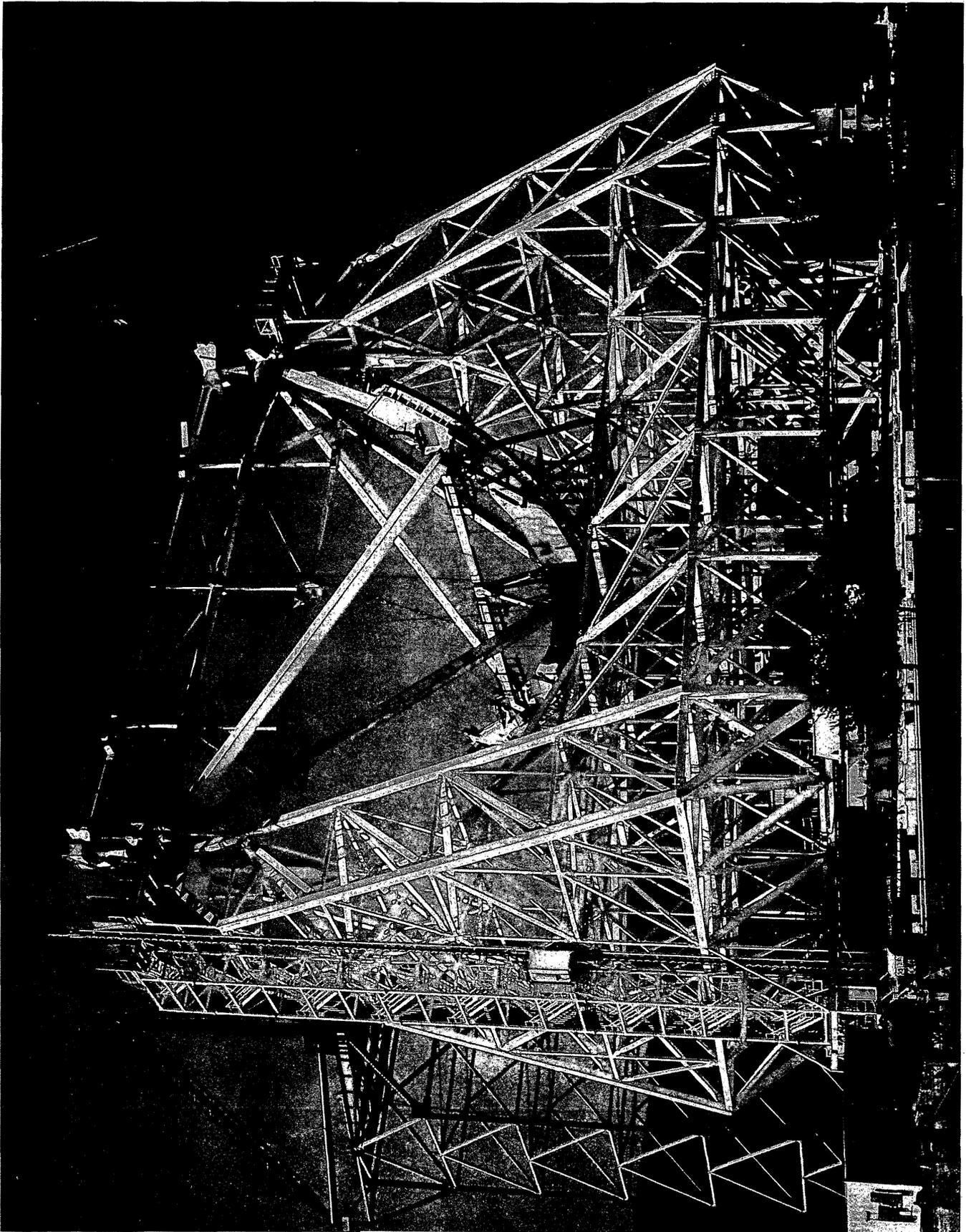
### GBT SYSTEMS AT THE 140 FOOT TELESCOPE

Early this year we made a detailed plan to test some GBT systems at the 140 Foot Telescope. Our objective was to bring together enough hardware and software being constructed for the GBT to allow thorough evaluation of design concepts and performance. This integration effort was divided into three phases. The first concentrated on continuum observations of the types which will be needed during the earliest commissioning phases of the GBT. The GBT Monitor and Control software was to be used to bring the antenna and selected portions of the GBT Electronics systems under coordinated control, and to acquire and store astronomical data. The AIPS++ project was to provide the tools necessary to display, manipulate, and analyze this data.

This first phase of GBT integration has been completed successfully and on schedule. Two blocks of 140 Foot time in late July and late August were used to do tipping scans, local pointing offset measurements, beam maps using RA and Dec scans, and similar observations. GBT M&C software was used to drive the 140 Foot through an interface program translating the GBT antenna commands to those appropriate to the 140 Foot.

The new GBT continuum backend was used to digitize detected total power and control front-end switching. Timing signals sent from the site Timing Center at the Interferometer Control Building over the new fiber optic distribution system were used by the M&C software to synchronize and coordinate the distributed processes used to control the antenna and the backends. Time-tagged data was written to separate disk files by the continuum backend, the antenna program, and other processes. AIPS++ tools were used by the observers to collate the time-tagged data into AIPS++ tables so that the data could be plotted, curve-fit, and otherwise examined. During the August time block, the GBT front-ends at the Cassegrain focus were used, together with two GBT Optical Fiber IF links, and the just-completed GBT IF conversion rack.

We were especially interested in evaluating the use of GLISH in conjunction with these tests. GLISH is a software system which is intended for use in distributed, real-time control systems to link and control distributed processes over local-area-networks. It includes an array-oriented interpreted script language which



was found to be nearly ideal for interactive control of the antenna and of the AIPS++ applications in use. The graphical M&C consoles, the flexible and powerful AIPS++ data manipulation and display utilities, and the interactive GLISH system provided a powerful debugging environment.

In October, the second phase of these integration tests will get underway, primarily continuing the building of more sophisti-

cated GLISH scripts and making the control environment easier to use. In March of 1996, we plan to begin the third phase by having in place the facilities necessary to allow spectroscopy and holography observations under control of the GBT systems.

*R. D. Norrod*

## ANNOUNCEMENT

The pace of activities surrounding the NRAO systems for the Green Bank Telescope has steadily increased this year, particularly in the area of computing. Dave Hogg has asked to be relieved of his general duties as Project Scientist so he can concentrate his efforts as Coordinator of GBT Pointing. I am

pleased to announce that Harvey Liszt has agreed to serve as GBT Project Scientist.

*P. A. Vanden Bout*

## 30TH ANNIVERSARY OF THE 140 FOOT TELESCOPE

On September 29 and 30 we celebrated the 30th anniversary of the 140 Foot Telescope with a Green Bank Workshop on the scientific achievements of the telescope and a party for all employees and former employees. About 60 scientists came to Green Bank for the Workshop. Although the focus was on the science accomplished by the 140 Foot, there were also a number of talks anticipating the GBT. The Workshop began with a talk by Peter Mezger, who reviewed the discovery of radio recombination lines, then continued with presentations on the discovery of formaldehyde by Lew Snyder and Pat Palmer, and on molecular spectroscopy by others. There were sessions on the development of VLBI, on continuum observations, and on the construction and evolution of the telescope. Many Workshop attendees were among the first users of the telescope, including Sebastian von Hoerner, Jaap Baars, Ken Kellermann, Mort Roberts, Dave Hogg, Joe Taylor, George Swenson, Marshall Cohen, Dave Heeschen, Bernie Burke, Tom Wilson, M. Kundu, Jim Moran, Frank Kerr, Carl Heiles, and Phil Solomon. The Workshop ended with a session on the technical evolution of the telescope, led by Fred Crews, Howard Brown, George Liptak, and Bob Vance. Many former employees and retirees turned out

to participate in the discussion. A Workshop Proceedings will be published next year.

On Saturday afternoon there was an open house at the 140 Foot Telescope. Hugh Van Horn, Director of the Division of Astronomical Sciences of the NSF, and Bernie Burke, of MIT and the National Science Board, gave the opening remarks. There were tours of the telescope from the control room to the spherical bearing, a concert of fiddle and banjo music, and a barbeque. Four hundred seventy-five employees and their families, retirees, and friends of NRAO were present.

The final event was on Monday, October 2, when the site was opened up for visits from about 750 West Virginia school children and their science teachers. They were treated to lab demonstrations, the workings of the newly refurbished Jansky antenna, and tours of the 140 Foot Telescope. Nature cooperated with the anniversary by supplying five consecutive perfect autumn days.

*F. J. Lockman*

## VLA

### VLA UPGRADE PROJECT

I am pleased to announce the formal organization of the VLA Upgrade Project with the appointment of Rick Perley as Project Scientist. In this position Rick will report to me through Miller Goss, Assistant Director for VLA/VLBA Operations. Rick will be responsible for the preparation of a Project Design Study to be completed by mid-1997 and for the general promotion of the project. The technical work required for the Design Study will be performed under the direction of Dick Sramek, who as Deputy Asst. Director in Socorro is responsible for VLA/VLBA engineering. The Design Study is intended to put the

Observatory in a good position to compete for any special funding opportunities that may arise and to have a well-defined project to present to the next decadal astronomy review committee. I want to thank all those who have contributed up until now to the VLA Upgrade effort, in particular, Tim Bastian, who led the organization of the Upgrade science workshop held in January, and Alan Bridle, who with Tim edited the proceedings of the workshop.

*P. A. Vanden Bout*

## VLA DEVELOPMENT PLAN PROCEEDINGS NOW AVAILABLE

The printed version of the VLA Development Plan is now available to interested individuals. This document contains the proceedings of the science workshop held in Socorro last January to discuss the science impact of proposed major enhancements to the VLA's sensitivity, frequency coverage, bandwidth, and spectral and spatial resolution.

Copies of this printed version may be obtained by contacting Betty Trujillo at the VLA (btrujill@nrao.edu). Alternatively, a

copy (minus the color cover and binding) can be obtained via the WWW under the "Major Initiatives" column on the NRAO home page (URL: <http://www.nrao.edu>).

Browsers can now efficiently review the document by accessing the hypertext format version, available through the same URL as listed above.

*R. A. Perley*

## VLA CONFIGURATION SCHEDULE

Configurations	Starting Date	Ending Date	Proposal Deadline
B	06 Oct 1995	08 Jan 1996	1 Jun 1995
CnB	19 Jan 1996	05 Feb 1996	2 Oct 1995
C	09 Feb 1996	15 Apr 1996	2 Oct 1995
DnC	03 May 1996	03 Jun 1996	1 Feb 1996
D	07 Jun 1996	09 Sep 1996	1 Feb 1996
A	27 Sep 1996	09 Dec 1996	3 Jun 1996
BnA	20 Dec 1996	06 Jan 1997	1 Oct 1996

The VLA is currently scheduling two large surveys. One will be done at nighttime in the DnC and D configurations (10<sup>h</sup>-24<sup>h</sup> and 14<sup>h</sup>-04<sup>h</sup>, respectively, for the 1996 D configurations), and one in the north galactic cap (07<sup>h</sup>-17<sup>h</sup>) 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 degree declination).

### Approximate Long-Term Schedule

	Q1	Q2	Q3	Q4
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
1999	D,A	A,B	B	C

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.

In 1996, the C configuration daytime will be about 23<sup>h</sup> RA and the D configuration daytime will be about 07<sup>h</sup> 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*

## FIRST SURVEY UPDATE (OCT, 1995)

In early October, the second edition of the FIRST survey catalog will be released via the WWW site <http://sundog.stsci.edu>. The catalog covers 1550 sq deg and contains ~135,000 discrete sources to a limiting flux density of 1 mJy. The area of sky extends from roughly 7.5 - 17.5 h RA and 28 - 42 deg decl. The images upon which the catalog is based will become available at an anonymous ftp site at NRAO ([baboon.cv.nrao.edu](ftp://baboon.cv.nrao.edu)) in

November. The images will also be available through the STScI data retrieval system.

A new round of FIRST observations will commence in October. The plan is to extend the survey south to 22 deg decl. over the same range of RA. In addition, a narrow strip of sky at 0 deg decl. will be observed between 21.5 - 3.0 hrs RA.

*R. H. Becker*

## NVSS SURVEY CATALOG AVAILABLE

The NRAO VLA Sky Survey (NVSS) source catalog is now available on-line. It was extracted from images covering about 21 percent of the sky north of  $\delta = -40^\circ$  and contains  $4 \times 10^5$  sources brighter than  $2.5 \text{ mJy beam}^{-1}$  at 1.4 GHz. The catalog will be updated as new images are produced. Search software for selecting sources from the catalog has been released.

NRAO master home page (URL: <http://www.nrao.edu>). The search software also has a WWW interface (URL: <http://www.cv.nrao.edu/NVSS/NVSS.html>). Catalog and image files can be copied via anonymous ftp (URL: <ftp://nvss.nrao.edu/pub/nvss/>).

*J. J. Condon*

The catalog, search software, images, and more information about the NVSS are all available on the WWW through the

## COMPUTING AT NRAO-NM

During most of the summer of 1995, a large-scale upgrade of the AOC computing facilities took place. The main aim of this upgrade was to improve computing facilities for visiting observers, but local staff also benefited. The improvement was threefold:

1) Four of our IBMs received new and faster disks. These are IBMs which are primarily used for large VLBA projects, in which AIPS task running times can be many hours, sometimes more than a day. Some of the most time-consuming tasks were limited in their speed of execution by I/O constraints. We hope that the new disks have improved that situation; we do not yet have any numbers on the performance increase. The old disks were distributed among the public Sparcstations and AOC staff.

2) All public Sparc IPX workstations received an upgrade using the Weitek chip. This chip is faster than the original CPU by a factor of 2. Experiences elsewhere with this Weitek chip indicate realistic performance improvements for AIPS tasks by a factor of 1.7. A selected number of non-public IPXs also received this upgrade.

3) We added three Sparc 20s, two of which are dual processor machines, to our pool of public workstations. They replace two IPXs which are now in use by local staff.

As a result, not only have reduction facilities for visitors improved, but we also – because we added to the computing power on their own disks – expect a smaller demand for public workstation time from our local staff. In parallel with the hardware upgrade, the operating system for most Sparc workstations was upgraded to Solaris 2.4.

A list of all public workstations and the rules for applying for time are accessible via the NRAO home page (click on VLA or on Socorro). We plan to make the registration process available on the WWW soon.

We would like to remind you about the new VLA database being developed at the AOC in conjunction with our data archiving project. This database is accessible on the WWW, with URL: <http://info.aoc.nrao.edu/doc/vladb/VLADB.html>. It allows querying the VLA database using various user supplied criteria, after which the program displays a list of observations satisfying these criteria. The database is not yet complete; it is growing as the archiving project proceeds. Currently, all data from 1976 through 1983 and from 1990 to present are in the database; work on the 1989 data has just begun.

G. A. van Moorsel

## ADDITIONAL Q-BAND RECEIVERS INSTALLED

If all goes according to plan, three additional Q-Band receivers will be installed in September and October 1995. They will be put on antennae 6, 11, and 20. This brings the number of antennae which are outfitted for operations at 7 mm to 13. Regarding the current VLA B and upcoming C array configurations, our plan is to place telescopes with Q-Band receivers on the innermost four stations, with the "13th" telescope on the fifth station on the north arm. We will again use the "spiral" configuration during D array (see the Q-Band section on the WWW for details). It has been suggested that during next year's A array (Sept-Dec 1996), we should configure the Q-Band antennae for highest resolution and good coverage. We urge all users who are interested in this configuration to send an e-mail message to [ebrinks@nrao.edu](mailto:ebrinks@nrao.edu). We will only go for this option if there is enough interest within the community.

On a related topic, we often get questions on the tuning range of the Q-Band receivers and on their behavior as a function of frequency. The accompanying graph shows the relative sensitivity as a function of frequency over the entire tuning range, i.e., from about 38 to 54 GHz. At the extreme ends of the band, the sensitivity drops because of the fall in amplifier gain. Note that the sensitivity drops off sharply below 40 GHz. At the high frequency side, the system temperature gradually increases as one approaches the oxygen line. Above 51 GHz and below 39 GHz, some receivers cease to function. The best performance is obtained near 43 GHz, which is where we have chosen the default bands for Q-Band continuum observations. This is also where most flux determinations of potential calibrator sources have been made.

Regarding absolute flux calibration, some progress has been made in recent months in determining the suitability of 3C 286 and 3C 48 for those purposes. Those users who need the latest information on this are advised to e-mail [bbutler@nrao.edu](mailto:bbutler@nrao.edu).

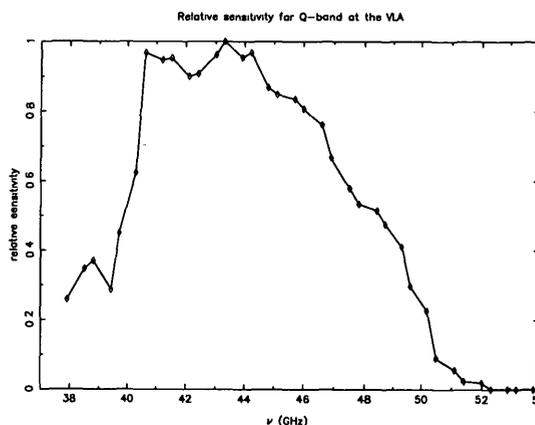


Figure 1 Relative sensitivity of the average of the ten Q-band receivers installed as of mid-September 1995 as a function of frequency

*E. Brinks and B. J. Butler*

## REQUESTS FOR VLA ARCHIVE DATA

All observers who wish a copy of their VLA observing data either on DAT or Exabyte tape or on an NRAO disk for copying by ftp should make their request to the VLA Data Analysts ([analysts@nrao.edu](mailto:analysts@nrao.edu) or (505)835-7359). This request can now be made by filling out a form accessed from the VLA part of the NRAO home page on the WWW (<http://www.nrao.edu>).

Although these requests can still be handled by e-mail to the VLA Data Analysts, we urge you to use the form since this will ensure that we have all the necessary information to send the tape without further contact with the observer.

*R. C. Bignell*

## TRANSPORTATION GUIDELINES - TO/FROM ALBUQUERQUE AIRPORT

1. NRAO continues to use the car rental agency, Dollar Rent A Car, when a rental car is requested by a visitor. The rate schedule is \$26 per day, plus tax, for an economy size car. The weekly charge is \$136.50 plus tax. These rates can only be obtained if made through the NRAO reservation system.

2. The commercial shuttle service, Socorro Roadrunner, is still an alternative for transportation. However, please note that the NRAO has eliminated the direct billing arrangement with Socorro Roadrunner. Travelers are expected to pay for the service directly in accordance with the shuttle service policy. As announced in the previous NRAO newsletter, the shuttle service

is requesting cancellations or changes in reservations be made with at least a three-hour notice. Notify the shuttle service at (505)835-1010, and if time permits, contact Eileen Latasa as listed in the last paragraph. NRAO cannot be responsible for changes in the shuttle service's published schedule. Their advertised schedule is:

Albuquerque - Socorro	Socorro - Albuquerque
0900	0600
1400	1100
1900	1600
2400	2100

3. A couple of GSA vehicles are available, with advance notice, for travel between Albuquerque and Socorro. A usage fee of \$25 each direction will be invoiced to the traveler by NRAO. A valid driver's license is required to operate a GSA vehicle. Visitors from outside the United States should possess both a valid driver's license from their country of residence as well as an international driver's license.

Reservations for lodging and transportation to or from Albuquerque should be made through Reservationist Eileen Latasa at:

E-mail: elatasa@nrao.aoc.edu  
Work Phone: (505)835-7357 (0800-1700 MST, Monday- Friday)  
Fax: (505)835-7027  
Home Phone: (505)854-2328

*M. T. Romero and S. Lagoyda*

## 12 METER

### SUMMER SHUTDOWN PROJECTS

The 12 Meter staff concluded another summer shutdown on September 12, and visitor observing resumed on that date. While the summer monsoons were in progress, the staff completed the following projects:

- **Hybrid Spectrometer On-the-Fly Acquisition.** A major accomplishment of the summer was the implementation of on-the-fly (OTF) data acquisition with the hybrid spectrometer. With the hybrid spectrometer OTF capability, observers have more bandwidth and resolution options to complement the filter bank OTF acquisition. In addition, the hybrid spectrometer is essential for OTF data acquisition with the 8-beam receiver, which is expected back on the telescope in late autumn. As with the filter banks and digital continuum backend, the hybrid spectrometer dumps data every 100 milliseconds, tagged with the actual telescope position. A major component of the project was developing a digital signal processing system that is able to perform the FFTs of the autocorrelations in real-time. The implementation is ready to be used by observers while refinements continue through the autumn. Filter bank OTF acquisition continues to be available simultaneously.

With the availability of both hybrid spectrometer and filter bank OTF observing, the data rate for OTF observing goes up considerably. The sustained data rates are now 4.9 MB per minute of observing, amounting to over 5 GB of raw data per typical day. We have recently installed several more high capacity disk drives, giving the Observatory about 32 GB of total raw disk space and 9 GB of AIPS reduction storage. Although this seems a huge amount of disk space by past standards, it can be exhausted in just a few days of OTF observing. The staff is developing data management procedures to cope with this deluge of data, but it will be essential that observers participate actively in data management if there is to be sufficient disk space.

- **2 and 3 mm and 1 mm Receiver Upgrades.** The receiver group made a number of improvements to the 2 and 3 mm receiver package. In particular, problems with noise pickup on the bias lines to the 2 and 3 mm mixers were addressed with better connectors and grounding. The excess noise, which affected continuum observing, is now much lower, although further improvements are planned.

The window material covering the dewar ports of the 1 mm receiver was replaced with a material that is less likely to absorb ambient water vapor. This should fix the anomalous noise temperatures in the 270-300 GHz mixer set that occurred last spring. Improvements to the sideband injection tone system and the mounting of the image sideband rejection filter are also underway. This receiver will be re-installed on the telescope on the first of November.

- **Eight-Beam Receiver.** Work on the 8-beam receiver was put on hold during the summer given the urgency of work on the other receivers. However, the receiver group has now resumed work and has completed the installation of the final four beams. As reported in the last Newsletter, the first four beams were successfully tested on the telescope in May. Work on the beam rotation system is also well toward completion. We have scheduled tests for the full receiver during several sessions in December and currently plan to release the receiver to observers in January.

- **Additional Computing Projects.** In addition to the hybrid spectrometer OTF implementation, several other computing projects were completed. An on-line data browser for the quick display of both OTF mapping data and conventional single-point observations is available. An improved, color status display allowing numerous monitoring and status windows was also installed.

- **Site Maintenance and Improvements.** The Operations Group was very busy this summer with the annual dome door and drive system inspection. As the result of an aggressive maintenance program, the failure rate of the dome door drive components has been brought to a very manageable level. The staff found only a small number of failed components this summer. The operations group upgraded the electrical systems on the telescope and have installed a new grounding system which we hope will diminish lightning damage which has affected the telescope almost yearly. The operations group also conducted their annual painting and sprucing up campaign around the dome and laboratory and have made some improvements to the comfort of the observer dormitory.

*P. R. Jewell  
(for the Computing, Engineering, and Operations Groups)*

## VLBA/VLBI

### VLBA STATUS

During the third quarter of 1995 (period ending September 16, 1995), a total of 46 projects was correlated (36 VLBA, 4 tests, and 6 global). The scheduling committee recently increased the amount of observing, and we are beginning to see the effects of this. The correlator latency (time between observation and correlation) recently increased from about 17 days to 28 days. This is due in part to a larger number of projects which cannot be correlated with a speed-up factor. In order to address the increased load, we shall, from October 1, run the correlator 24 hours a day, 7 days a week. This will result in a 40 percent increase in the time available for astronomical correlation.

The handling of Global projects is still not routine, but is improving. The problems encountered range from the late arrival of tapes, the incompleteness of log information, the need for clock searches, and the need for an increased level of

scrutinization. Improvements currently being implemented in the EVN will alleviate some of these problems shortly.

The correlator software upgrade is progressing at a steady pace and early tests have been encouraging. Until the upgrade is completed, we still cannot tackle the backlog projects that contain source and/or frequency sub-arraying, have many short scans, or do not have synchronized tape changes.

Nature has tested the VLBA recently. The St. Croix antenna suffered a near miss by Hurricane Luis in August, but was hit almost head on a few weeks later by Hurricane Marilyn. Luckily the antenna appears to have survived unscathed.

*P. J. Diamond*

### VLBI NETWORK CALL FOR PROPOSALS

Proposals for VLBI network observing are handled by the NRAO. In particular, the Global Network sessions for 1996 are expected to be as follows:

Session	Dates	Bands	Proposal Deadline
1	07 Feb to 28 Feb	18, 0.7, 1.3	2 Oct 1995
2	16 Oct to 06 Nov	TBD	1 Jun 1996

The planning of sessions in 1996 is uncertain because of unknown timing of major maintenance work on the Effelsburg Telescope. There may be a global session in May, in addition to the two listed above. Planning will be even more uncertain in 1997, as a large part of the effort of the VLBI antennas in both Europe and the US will go to the support of space VLBI with VSOP. As soon as plans become firm, details will be sent on the VLBI e-mail exploder (send subscription requests to [vlbi-request@nrao.edu](mailto:vlbi-request@nrao.edu)).

Proposers should note that Mark II format recording is supported neither on the VLBA nor on the EVN.

It is recommended that proposers use a standard coversheet for their VLBI proposals. Fill-in-the-blanks TEX files are available by anonymous ftp from <ftp.cv.nrao.edu>, directory proposal. Printed forms, for filling in by typewriter, are available on request from Lori Appel, Socorro.

Any proposal requesting NRAO antennas and 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. Proposals requesting use of the Socorro correlator must be sent to NRAO even if they do not request the use of NRAO antennas; proposals for the use of the Bonn correlator must be sent to the MPIR if they do not request the use of any EVN antennas. For Global proposals, or those to the EVN alone, send proposals to:

R. Schwartz  
Max Planck Institut fur Radioastronomie  
Auf dem Hugel 69  
D 53121 Bonn, Germany

For proposals to the VLBA, or Global proposals, send proposals to:

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

*B.G. Clark*

## IN GENERAL

### THE MILLIMETER ARRAY

Nearly a year ago the National Science Board (NSB) agreed to "endorse further planning" for the MMA, a charge which, in the intervening months, has been translated into the specific action of an Astronomy Division request for initial funding for the design and development phase of the MMA in FY 1997 from the NSF Major Research Equipment program. We will not know until the President's state of the Union address in January whether or not that request is incorporated in the President's budget planning for 1997. We are hopeful that this will be the case in view of the NSF's strong support for the scientific peer-review process and the fact that the MMA was so highly rated in the decadal review of astronomy and astrophysics.

The prospect of funding in little more than a year's time has accelerated planning for the instrument. Presently, there are both scientific issues and technical issues that need to be dealt with before firm decisions are made. As a means of addressing these issues, a MMA Science and Technical Workshop will be held October 5-7 in Tucson that will bring together a number of interested scientists and instrumentalists/engineers. We expect that the result of that meeting will be a clear set of MMA specifications, a priority list of instrumental capabilities, and a

wish list of added capabilities, or what might be thought of as goals to be achieved should technical advances or cost reductions permit.

In preparation for the Tucson workshop, the working groups of the Millimeter Array Development Consortium have each prepared technical summaries of the issues facing the array design in their specific areas. These summaries provide a very comprehensive overview of the MMA project, and I encourage everyone who is interested in development of the MMA to read these documents. All the material for the workshop is on the World Wide Web; the URL is [http://info.aoc.nrao.edu/mma/meetings/workshop\\_top.html](http://info.aoc.nrao.edu/mma/meetings/workshop_top.html).

At the conclusion of the workshop, there will be additional material written by each of the six workshop working groups, and these too will be posted on the WWW and accessible from the above URL. You can also reach this material from the NRAO home page (<http://www.nrao.edu>) following the MMA path.

*R. L. Brown*

### AIPS++ PROJECT STATUS

The AIPS++ Project staff participated in the GBT systems integration tests on the 140 Foot Telescope, starting in July 1995. AIPS++ provided analysis capabilities for data produced by the GBT Monitor and Control system. Data from multiple FITS binary tables which varied at different rates were filled into an AIPS++ table, and manipulated using the Glish control hub and command-line interface. The data could then be subject to arithmetic operations inside Glish or sent to Glish client programs for fitting or plotting. A fuller demonstration of the type of analysis performed has been generated by Bob Garwood and Rick Fisher, and is available from the "What's New" link on the AIPS++ WWW home page. We are very pleased with the success of the tests since it shows the basic correctness of the object-oriented approach, used by both the GBT Monitor and Control system and AIPS++, as well as demonstrating the quality and utility of code that has been developed over the last few years by the AIPS++ Project. The work at Green Bank is the precursor to the longer term development of single dish analysis capabilities inside AIPS++.

Synthesis processing inside AIPS++ is being developed using a new formalism for polarization calibration and imaging. The goal is to be able to provide a unified treatment of polarization calibration and imaging for many different types of synthesis arrays. A number of recent memos available from the AIPS++ documentation system describe this work in detail.

Work continues in many areas of AIPS++: a set of classes for coordinates is being written by Wim Brouw at ATNF, numerous improvements to Glish are being made, a powerful Glish client for plotting has been written using a commercial widget (this will be changed to a public domain widget before public release of AIPS++), the documentation system is being continually augmented, and a tiled storage manager is being written for the AIPS++ Table system (thus allowing data cubes to be accessed efficiently without transposes, and efficient access to UV data in time or baseline order without sorting).

The Project Center has now largely moved to the AOC and will be fully staffed in January. The last remaining major change is the move of the master code repository, planned to occur in October. Interaction between the AIPS++ consortium sites remains at a high level, and is aided by frequent short-term and long-term visits. Mark Wieringa of ATNF is currently visiting the AOC for six months to work on synthesis processing.

More information on activities and plans of the AIPS++ Project may be found starting from the AIPS++ home page, reachable from the NRAO home page.

*J. T. Cornwell*

## AVAILABILITY OF COMPUTER TIME ON POWERFUL DIGITAL WORKSTATION

Digital Equipment Corporation (Digital) has placed an advanced AlphaStation at the NRAO for the software porting of AIPS and to give the new technology exposure to the scientific community.

The equipment will be at the NRAO until at least January 1996 with possible extensions for a longer period. We have agreed to make the system available to members of our scientific user community. It will be available for use both in person in Charlottesville and via the Internet on a scheduled basis.

**Equipment Description:** A 2D AlphaStation 600 5/266 workstation with 128 MByte Memory, 4 MByte cache, 2 GByte disk, a 2D graphics accelerator, and a 20 inch color monitor. The NRAO has provided two 4 GByte disks which can be used for AIPS data storage. The AIPSMARK(93) for this machine has been measured at 8.1 to 8.4.

**Visitor Use:** For visitor use the system will be made available through our current Charlottesville visitor program managed by Jim Condon (jcondon@nrao.edu).

**Remote Use:** Remote access use will also be scheduled through Jim Condon. We will try to schedule people so that their usage does not collide. People executing non-AIPS codes may be asked to do so at a low priority.

**Reserved Time:** We reserve the right to allocate time for tests (AIPS, operating system, compilers, etc.). We will make every effort to give a two day's notice of any interruption.

**Data/Tape Handling:** The main problem comes from users wishing to process the large datasets from the VLA, VLBI, etc. These datasets are generally too large for responsible transmission over the Internet. Users will be asked to send their data tapes ahead of time to Ernie Allen (eallen@nrao.edu), who will make arrangements for the data to be loaded onto a disk reserved for their use. This will be done on a time-available basis. Small datasets ( $\leq 10$  MByte, please) can be transmitted via ftp. At the end of the scheduled time the disk will be cleared. If requested, the disk contents will be copied to tape and the tape sent to the user.

**Logon:** We will provide a dedicated logon to this computer, if necessary. People doing AIPS data reduction should use the normal AIPS logon. The password may be obtained by phone from Ernie Allen (804)296-0209, i.e., not via e-mail.

**Internet:** The computer is connected to the Internet (siamang.cv.nrao.edu). As mentioned above, small datasets may be sent via ftp.

**The Cost:** We would appreciate it if users who are granted time under this program would write a note to Digital expressing satisfaction with the computer. Please send this note to Gareth Hunt (ghunt@nrao.edu).

*G. C. Hunt*

## REPORT OF THE 1995 NRAO USERS COMMITTEE

The NRAO Users Committee met in Green Bank, WV, on May 12-13, 1995. This summary was prepared from the Report of the meeting. A copy of the full report may be obtained on request from the director's office, Charlottesville.

Despite the current era of extreme fiscal constraint, NRAO has done a remarkable job to maintain its current facilities and level of service to the user community, while pursuing several exciting new developments. These include on-the-fly mapping on the 12 Meter Telescope, impressive 43 GHz images from the VLA, two major VLA sky surveys, construction of the Green Bank Telescope, and the bringing into full operation of the VLBA. Future plans include the VLA enhancement and the Millimeter Array; the Committee is pleased that wide community involvement and support is being sought in laying the groundwork for these new endeavors, in the form of science workshops. NRAO should also actively pursue technical partnerships with university, commercial, and other research groups. This is vital to the long-term health of radio astronomy in the US.

Several Observatory-wide topics were discussed. The Committee commends NRAO on its continuing policy of

granting open access to its telescopes on the basis of scientific merit. It is important that this extend to the Millimeter Array, consistent with ensuring telescope access for any international partners. We expressed some concern that certain classes of VLA and VLBA projects, particularly those large programs which require repeated observations (including sky surveys), are not assured continuity, even after favorable review and initial observing time. NRAO should state guidelines for how such proposals will be received, reviewed, and (if allocated time) monitored for progress.

Radio-frequency interference is an ever increasing concern. We applaud NRAO's efforts in enforcing the requirements designed to protect the National Radio Quiet Zone from unnecessary interference. With an increasing dollar value attached to spectrum allocation, especially satellite-based, NRAO should continue active relations with CORF and other bodies which set national and international spectrum policy. It should also invest in equipment necessary to properly log interference in and near the radio astronomy bands.

The Committee was impressed with progress on the GBT construction, but is concerned that the contractor maintain the

schedule for handover of the completed telescope, as this impacts both the budget and the schedule for other GBT tasks. The feed arm oscillations expected from structural modeling would seriously impact many kinds of GBT observations. We applaud NRAO's frank presentation of the problem, and the vigorous efforts to correct it. Pointing of the GBT is one of the biggest challenges ahead; lab testing of the laser rangefinders has been successful, but the planned use of the 140 Foot Telescope to test the system is absolutely crucial and should not be delayed. Receiver testing on the 140 Foot is a benefit to both telescopes. Full remote observing capability must be part of the plan for GBT telescope monitor and control. Indeed, this will become increasingly important at all NRAO telescopes.

NRAO remains in the forefront of receiver development through the Central Development Laboratory, and this Committee endorses the emphasis which NRAO places on the CDL: developing stable, wide-bandwidth, low-noise receivers and feeds is essential for all modern radio telescopes. The CDL's forward-looking attitude will become increasingly important as the Millimeter Array and the VLA Enhancement approach their construction phases.

On-the-fly mapping revolutionized single-dish observing at the 12 Meter Telescope. The Committee was impressed with the benefits, including improved sensitivity to extended structures, the ability to build up images by repeated scans (reducing weather effects), but most importantly the observing-time savings which enable much more ambitious projects to be contemplated. NRAO should continue full support of the 12 Meter Telescope until the MMA is completed. Data reduction remains a major concern for OTF mapping. Continuum OTF mapping is not currently possible, and while AIPS represents a usable route for spectral-line analysis, it remains limited in functionality and hard to use. The 12 Meter is an important resource for millimeter-wave VLBI observing, so efforts to develop a fiber link to the VLBA antenna and data acquisition terminal should continue.

Q-band receivers have brought an important new scientific capability to the VLA, and the Committee was impressed with their performance, and with the many new scientific results. Dynamic scheduling will be needed to make best use of Q-band, especially if longer baselines are used. We are in favor of an incremental approach to implementing some of the less expensive features of the VLA Enhancement Project. The VLA as a survey instrument is now producing a large database of valuable data from the two L-band sky surveys, and we applaud NRAO's adoption of this large undertaking for the community.

The Committee was impressed by the variety of results now coming from the VLBA, and appearing in the journals, especially in its unique capabilities like 43 GHz imaging. We look forward to the advent of space VLBI which NRAO plays

a key role in. As the VLBA approaches maturity, many of the vexing questions of its development have been laid to rest. However, much remains to be done to make it stable and user-friendly like the VLA. Most correlator modes have been well-tested (with the notable exception of pulsar gating), but the analysis tasks in AIPS are still daunting to novice users. Reliance on feedback from users for bug reports must be reduced, as the software matures. Documentation is improving, but much more is needed.

Continued maintenance of AIPS is essential, even with AIPS++ on the horizon; it remains one of NRAO's major services to the community. Inadequate documentation is a perennial concern. Effective use of new tasks, e.g., in VLA imaging, depends on improved documentation.

The Committee is pleased to see that the major recommendations of both the AIPS++ Review Committee (which met in December 94) and the AIPS++ Subcommittee of this Committee have been implemented: the AIPS++ Project now has a full-time manager, and is treated as a construction project with separate budget and personnel. However, the credibility of the project depends on its producing a usable end-to-end package for astronomical use within a year. A complete single-dish observing system in AIPS++ in that time frame is a critical milestone. User input at the level of command-line and graphical interfaces is needed right away. The GBT project must complete its evaluation of AIPS++/GLISH as a suitable telescope control language as soon as possible.

The Millimeter Array project is progressing well, and the recent NSF endorsement is a major milestone. The Committee approves of NRAO's seeking international partners (as required by NSF) via a carefully worded Prospectus. Continued close collaboration with university groups is essential, to ensure that the tremendous expertise and hardware techniques developed there are properly applied to the MMA design. We have some concern that the detailed antenna design may be advancing before the most serious technical and atmospheric constraints have been properly studied. The proposed MMA site in Chile appears a good alternative to Mauna Kea, and we await results of phase stability monitoring with interest. NRAO should continue exploring all the key logistics questions associated with both sites.

The Committee Chair for the 1996 Users Committee Meeting will be Mary Barsony. Subcommittee members are: (VLA/VLBA) Jim Cordes, Colin Lonsdale, Bob Mutel, Jacqueline Van Gorkom, Rogier Windhorst; (MMA) Mary Barsony, Jacqueline Van Gorkom, John Black; (GBT) Morley Bell, Jim Cordes, Roger Foster; (AIPS++) Mary Barsony, Roger Foster, Lloyd Higgs, Colin Lonsdale, Bob Mutel.

*Stephen C. Unwin, 1995 Chair  
California Institute of Technology*

## USER SURVEY

From time to time funding agencies and their advisory committees ask us for statistical information on the sources of funding for the research conducted at the NRAO by our users. Beginning with the proposals selected for VLA and VLBA time after the deadline of this past June, we are asking the PIs to complete a simple e-mail questionnaire. If this exercise

proves useful, it may be continued and expanded to the single dishes. Please note that it *follows* proposal refereeing and selection; the source of funding is irrelevant to that process. Your cooperation will be appreciated.

*P. A. Vanden Bout*

## 1995 SUMMER STUDENT REPORT

The 1995 Research Experiences for Undergraduates at NRAO has ended with the 19 students heading for their colleges from the four NRAO sites. As examples of the sorts of research students and their advisers undertake at the four NRAO sites, we give a short summary of the activities of several students.

Student David Copeland (Reed College) worked with David Nice (Charlottesville) on a project to search for fast (millisecond) dispersed transient signals in rapidly sampled spectral data from Arecibo Observatory. Such signals could come from pulsars or possibly other (unknown) Galactic phenomena. Copeland worked on the analysis routines for this project, both developing and optimizing the specific algorithm for the search and developing the overall software system. This involved quite a bit of coding in C, both reworking old routines and developing a single, coherent package. The algorithm development included many software runs on test data to study and fine-tune the search algorithm. David also processed data to form images taken at NRAO's 12 meter telescope, as a supplementary project with Al Wootten, which he is continuing for his senior thesis at Reed.

Larissa Bowles, of the University of Virginia, worked with Kathryn Mead and Marc Kutner in Tucson on a project which involved imaging CO(J=2-1) (1.3 mm) emission from a section of M31 believed to have strong magnetic fields (to tell us something about the relationship between magnetic fields and star formation). The observations were carried out in May 1995 on the telescope, located on Kitt Peak. A 4' x 4' region was mapped using a new technique, On the Fly (OTF) mapping. Ms. Bowles combined the 70 maps of the region into a single image, detecting and deleting bad data, arranging all of the observed points onto a regular grid and collecting the results into a data cube that could be further analyzed.

Thomas Wilson (University of Nevada at Las Vegas) worked with Dana Balser in Green Bank. The data consisted of two sets of 11 continuum maps of classical HII regions at 8.7 GHz. The high resolution maps were obtained at the VLA in the D-array configuration. The single-dish maps were taken by the MPIR 100 meter telescope to recover the zero-spacing flux. Mr. Wilson made two major contributions: (1) he improved the signal-to-noise ratio of the VLA maps by self-calibrating the data; and (2) he combined the interferometer data with the single-dish data using the AIPS task TESS, which uses the maximum entropy method. The results are much more sensitive and accurate maps of these regions. The primary goal

is to use these maps to constrain models of the density and ionization structure of these HII regions.

Amy Hronek (Occidental College) worked with Craig Walker in Socorro on two projects during the summer of 1995. The first was an effort to characterize the system temperature, gain, and overall sensitivity of the VLBA antennas as a function of frequency across the full range that can be observed in each band. This project involved several sessions of single dish observing using all of the VLBA antennas and reduction of the monitor data using both standard VLBA software and a new program that she and Walker wrote. The project will result in a VLBA Test Memo which she wrote and Walker is in the process of finishing. The second project was a test of the ability to make high dynamic range images using VLBA data recorded in the 2 bit mode. All previous high dynamic range tests had been done in 1 bit mode. This project involved one session of VLBA interferometric observing, correlation on the VLBA correlator, and reduction of the data in AIPS and SDE. Amy did most of the data reduction. The test was successful, and Walker will write a very short memo to that effect based on her work.

Information and application forms will soon be mailed soliciting applications for research assistantships next summer. The majority of the assistantships will be offered to undergraduate students who are currently enrolled in U.S. undergraduate institutions and who will not receive their degrees before or during the summer of 1996. A limited number of assistantships may be available for graduate students or students from non-U.S. institutions.

Owing to the large number of applicants and the difficulty of distributing materials among sites across the continent, the deadline for receipt of application materials will be January 19, 1996; notice of decisions will be sent by March 1, 1996. Forms are available from Department Heads, on the WWW (URL: <http://www.cv.nrao.edu/html/headquarters/summer-students.html>), or by writing to:

Director, Summer Student Program  
National Radio Astronomy Observatory  
520 Edgemont Road  
Charlottesville, VA 22903-2475  
804-296-0225

*H. A. Wootten*

## 1996 JANSKY POSTDOCTORALS

Applications are now being accepted for 1996 Jansky Postdoctorals at the NRAO. Individuals holding Jansky Postdoctorals formulate and carry out their research program either independently or in collaboration with others within the wide framework of interests of the Observatory. Minority applicants, female applicants, and applicants with research interests in the development of astronomical instrumentation and in image processing are especially encouraged.

The full NRAO observing, computational, and support facilities are made available to Postdoctorals. The Postdoctoral appointment also includes a travel budget, scientific page charge support, as well as vacation allowance, health insurance, moving allowance, and other benefits.

Appointments, which may be assumed at any of the NRAO sites, are made for a term of two years and may be renewed for a third year. Stipends for 1996 will be approximately \$34,000. Postdoctorals must have received their Ph.D. prior to beginning the appointment. Preference will be given to recent Ph.D. recipients (1995 or 1996).

Application may be made to:

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

The application should include a curriculum vitae and a brief statement of the type of research activity to be undertaken at the NRAO. The applicant should have three letters of recommendation sent directly to the NRAO.

The application deadline is December 15, 1995. All letters of reference must be received by December 29, 1995. The announcement of the Jansky Postdoctoral appointments will be made in compliance with the AAS resolution on uniform notification dates for postdoctoral appointments.

*R. L. Brown*

## NEW NRAO WWW PAGES

The NRAO Library is pleased to announce the availability of two new WWW pages. NRAO Hosted Meetings, Conferences, and Workshops includes information on both forthcoming and past meetings sponsored by NRAO, as well as links to available full text proceedings of NRAO-sponsored meetings. The URL is: <http://www.cv.nrao.edu/html/library/meetings.html> or click "Meetings & Workshops" on the NRAO home page (<http://www.nrao.edu/>). If you have meeting information you would like included on this page, please contact Ellen Bouton, [library@nrao.edu](mailto:library@nrao.edu).

The NRAO Library Catalog has a fill-in form for searching the catalog of NRAO library holdings at all site libraries. The URL is: <http://www.aoc.nrao.edu/NRAOLIB.html>. You may also access the catalog from the link on the NRAO Library Page <http://www.cv.nrao.edu/html/library/library.html> or through the "Library" button on the NRAO home page.

*E. N. Bouton*



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