# NRAO NEWSLETTER

1 January 1995 No. 62

## IN GENERAL

### 1995 BUDGET

The budget received from the National Science Foundation for operating the NRAO in 1995 is exceptionally tight and the year ahead will be difficult. NRAO will receive $28.870M for 1995, less than the $29.020M we had in 1994, and less even than the $28.900M we had in 1993. But the real erosion of total budget, serious as it is, is worsened by other factors.

The 1995 budget must also accommodate two items critically important to the future of the Observatory. First, NSF has directed that $500k of the budget be spent on the Millimeter Array Project as a precursor to major development funding in subsequent years. Second, NRAO will begin in 1995 to move people from the Green Bank Telescope construction budget to the Green Bank operations budget. These transfers must be accomplished over the next two years if we are to have the trained operations staff required for the GBT. Whatever can be done in this regard in 1995 will be done within reduced budget resources, not with additional operations funds that were requested for this purpose.

The Observatory will survive the coming year, and I am sure a great deal of excellent astronomy will be produced. But it will not be easy and will come at a price. The scheduled increase in staff compensation for 1995 has been cancelled. Tight restrictions will be imposed on personnel levels, travel, and purchases of goods and services. The instrumentation program will be budgeted at half the already low level of recent years. New Jansky Postdoctoral appointments will not keep pace with departures.

We will make every effort to provide NRAO users with the same efficient operation of the facilities they have had in the past. The assistance NRAO provides to users in the form of travel, page charges, availability of low-cost housing at NRAO sites, support of data reduction software systems, and support of remote observing will also continue, insofar as is possible. But users need to understand that the declining support will eventually erode the Observatory's ability to provide timely, cost effective solutions to their needs. Progress on new instrumentation and software will be slow. Response to equipment failures and software problems will take longer. We appreciate the support and understanding of our user community as we confront the difficulties of the next year.

NRAO's situation is not unique, but rather is a consequence of NSF's funding level for astronomy. This level reflects the Foundation's priorities over the past decade, and in turn, the larger context of support for basic research in the U.S. It is most important that we as scientists communicate the importance of basic research to those planning national science policy.

P. A. VANDEN BOUT

### MILLIMETER ARRAY

The last few months have been a busy and exciting time for the Millimeter Array project. In this time, (1) an agreement has been signed to form the Millimeter Array Development Consortium (MDC); (2) the National Science Board of the NSF has approved the MMA Project Development Plan; and (3) the MMA Advisory Committee met and has released their report.

**The MDC**. The MMA Development Consortium is an agreement between the NRAO, OVRO, and the BIMA institutions to work together to promote the development of the MMA, to assure that students and postdoctorals have continued access to facilities for astronomical instrumentation development and research at millimeter wavelengths, and to enhance collaboration between the national observatory and university interferometry groups. The MDC is a mechanism designed to recognize that the pioneering work done at BIMA and OVRO in the development of millimeter-wave interferometry has produced unique expertise in the field from which the MMA project can benefit, and the expectation that the MMA project will produce developments of benefit to OVRO and BIMA which will further the long-range plan of both university groups to combine their respective facilities at a single site.

The MDC will provide overall direction for the development phase of the MMA. The MDC will be managed by an Executive Committee of four members – two representing NRAO (P. Napier and R. Brown) and one each from BIMA (W. J. Welch) and OVRO (N. Scoville) – reporting to the Director of the NRAO. The Executive Committee will define major MMA-related development issues and tasks, identify personnel from the member

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institutions to work on these tasks, and construct the task budget for funds made available to the NRAO by the NSF for design and development of the MMA.

**The NSB Action**. On November 18 the National Science Board approved the Project Development Plan (PDP) for the MMA. Formally, this approval endorses further planning for the project, and requires that the Board be kept informed of further progress. However, the approval also means that the MMA project is deemed potentially suitable (by a series of NSF criteria) for construction funding from the NSF Major Research Equipment budget line. Note that this doesn't constitute any sort of approval for construction of the MMA, only that it is eligible to compete for funding within the NSF for funding from the MRE funds. (MRE currently funds the Gemini project and LIGO.) Approval of the PDP is a necessary first step for the project's possible inclusion in the President's budget at some time in the future.

With the approval of the PDP, we are hopeful that some modest funding will be available to allow us to accelerate the site evaluation work ongoing at the NRAO and to begin in earnest a variety of technical evaluations of observing techniques and hardware design through the MDC.

**MMA Advisory Committee**. The MMA Advisory Committee also met, coincidentally, on November 18. The meeting this year was at the Array Operations Center in Socorro. The committee was given a comprehensive overview of the project, including the developments at the NSF and those leading to the concept of the MDC. The report of the committee, compiled by the committee chair, Neal Evans, is reproduced below. We expect to follow the committee's recommendations regarding increased community involvement with the project and for the science workshop. Details will be given in future Newsletter articles and in the MMA pages on the WWW.

R. L. BROWN

## REPORT OF THE MMA ADVISORY COMMITTEE – NOVEMBER 1994

The Advisory Committee had a brief session at the end of the recent meeting in Socorro and produced the following items:

1. We endorse the formation of the MMA Development Consortium (MDC). We see it as an important step toward a more consultative mode for NRAO in the development of the MMA.

2. We would like to see this more consultative mode extended to the MMA Advisory Committee (MAC, on the theory that we can't be taken seriously without an embedded acronym). We would like to be made aware of the agenda for meetings of the MDC Executive Committee and the significant results of these meetings.

3. If the MMA development proceeds as it is currently envisioned, we believe that a new Science Workshop should be convened in 1995. We are willing to help in the scientific organization of this workshop. We also would be willing to assess the results of the workshop in terms of the scientific value of different capabilities.

4. We believe that the workshop should not start from scratch as previous workshops did. Instead, two broad questions should be addressed: a. What developments in the intervening years have changed the nature or importance of the science proposed in the last workshop? b. How strong is the scientific case for capabilities that are driving the design in difficult directions?

5. To address the second question in #4, the workshop should consider specific tradeoffs or requirements driving the design, which are defined by the ongoing design study. Issues which we identified are as follows:

a. The rationale for solar observations.
b. Low frequency (less than 70 GHz) observations.
c. High frequency (greater than 400 GHz) observations.
d. Resolution times bandwidth for the correlator (how many channels needed at highest bandwidths?).
e. Need for baselines greater than 1 km.
f. Southern hemisphere versus northern hemisphere science.
g. Large mosaics with many pixels.
h. Polarization.

The above points were specifically agreed to by the members of the advisory committee. Other comments were made by one or more people, either at the meeting or by e-mail response to the first draft. These are not necessarily agreed to by everyone. I have tried to indicate the degree of agreement by listing them in order of how many people mentioned them.

1. There was broad support for the notion that the MAC should serve as the mechanism for involving the broader astronomical community in the planning, design, and oversight of the project. We would like to work with NRAO on planning the agenda of future MAC meetings. We are also willing to consult on the complex question of site selection, particularly in weighing the impact of the choice of site on the scientific potential of the MMA. The Science Workshop should also consider this issue before any final decision is made. Our committee is also willing to serve as the science "watchdog," helping to set priorities and making sure that important scientific capabilities aren't eliminated without a compelling reason as the project proceeds.

2. Most people agreed with the proposition that the bread and butter of the MMA will be at frequencies from 200-370 GHz.

3. Someone noted that we should be aware that things we can't imagine doing now (e.g., large mosaics) may still be useful capabilities, even though most did not believe that such capabilities should be major drivers at this point. This issue should be addressed by the Science Workshop.

4. While most of us favored a science workshop focused on new developments and tradeoffs, there was some sentiment for a more open workshop, on the theory that we need the broadest possible involvement and support by the millimeter community.

5. There may be a need for support for relevant theory efforts. This issue should also be addressed by the Science Workshop.

N. J. EVANS, CHAIRMAN

## SITE TESTING ACTIVITIES

A site-testing interferometer, along the lines of that developed earlier by Colin Masson, has been designed and constructed in Tucson. This interferometer monitors a beacon at 12 GHz from one of the nominally geostationary earth satellites and records interferometric phase fluctuations using a baseline of a few hundred meters. The first of these interferometers is already collecting data at the VLBA site at Mauna Kea, returning data and status information daily to the Tucson NRAO offices. A second interferometer is nearing completion, and will be deployed, using solar power and a satellite data link, at a potential MMA site in the southern hemisphere.

D. T. EMERSON AND S. J. E. RADFORD

## AIPS++

The two most exciting recent developments for the AIPS++ project are the creation of an application to do On-The-Fly (OTF) imaging for 12 Meter data and the development of an application, AipsView, for image display and visualization. The current version of the AIPS++ OTF imaging procedure fills NRAO 12 Meter OTF data into an AIPS++ table, applies calibration, regrids the data, and produces and displays an output image cube. So far, this merely demonstrates that AIPS++ can replicate current capabilities. This capability will become very interesting in the coming months, however, because it will soon be possible to do this in near real time with AIPS++, allowing observers to see an OTF image building up while the data is being taken. This should provide an important capability for observers at the 12 Meter, and will also help bring AIPS++ into closer contact with future users. AipsView, developed by the BIMA AIPS++ group in Illinois, is a flexible tool which allows users to display and manipulate 2D and 3D image cubes easily. It will be useable in both the AIPS++ environment as well as a stand-alone image visualization tool when it is released.

During recent months several developments within AIPS++ have occurred that are of particular importance to programmers. A major revision to the AIPS++ table system (which handles data structures for AIPS++) has been completed as planned, and will provide a firm foundation for application development during 1995. The incorporation of Glish (a system which implements both command line interface and interprocess control and communications via a "software bus") into AIPS++ has proceeded well. The AIPS++ extensions to Glish (including support for multidimensional arrays, complex numbers, and command line editing) have been released by NRAO and will be part of the next "official" release of Glish. A number of high-level routines have been bound to Glish, demonstrating that users will ultimately be able to make use of much of the AIPS++ programming library directly from the command line. In other areas: code acceptance procedures are now fully implemented, which is having the expected positive effect on coding for AIPS++, especially in areas related to documentation and testing. Related to that, a documentation extractor has been developed which can produce sensibly formatted and suitably cross linked documentation from standard AIPS++ programs.

In December there was a major review of the AIPS++ project by a panel of outside experts. The review looked at both technical and managerial aspects of the project. The panel endorsed the importance of AIPS++ to the future of radio astronomy and reacted positively to many of the technical approaches adopted by AIPS++; it also criticized the management and structure of the project and the AIPS++ Consortium. The Consortium (and the AIPS++ Steering Committee) is still digesting their advice, and expects to implement changes in the coming months to address concerns raised by the panel. The full report of the review panel will be released in January as an AIPS++ Memo. A considerable amount of documentation was prepared for the review, including a major document on the design of AIPS++.

The AIPS++ project is now nearing the end of the first major phase in its development. The focus during the coming months will be moving from primarily infrastructure development towards development of applications in selected areas.

R. S. SIMON

# GREEN BANK

## GBT NEWS

Tractor trailers loaded with large fabricated steel members are arriving regularly at Green Bank. The current major site effort is the preparation of the elevation shaft for installation on the completed alidade. The stub shafts have been aligned and welded onto the axle, and trial erection of the elevation wheel is underway. The shaft is scheduled to be lifted onto the alidade later this winter. Other tasks completed or nearing completion on the structure include caulking the azimuth track gaps and installation of HVAC equipment, electrical furnishings and servo cable trays. At the contractor's plant, fabrication continues on the main reflector panels as well as on the subreflector. The servo system is being prepared for acceptance testing in February.

Three GBT receivers, the 8-10 GHz, 18-26.5 GHz, and the recently installed 12-15.4 GHz, are now available for routine use on the 140 Foot Telescope (see associated article by R. Maddalena). The 3.95-5.85 GHz front end has been completely assembled, and the L-band feed is nearing completion. Detailed testing has started on the first 1-8 GHz IF converter module.

The spectrometer is making good progress now that the latest production run on the spectrometer chips has been successful. However, to insure an adequate performance margin, it was decided to decrease the system clock rate from 125 MHz to 100 MHz. This means the spectrometer maximum bandwidth will be 800 MHz, which meets the original performance goals set by astronomical considerations, but is less than the 1 GHz bandwidth we had hoped to achieve.

Tests of the active surface actuators are continuing—one unit has run for over 8800 hours without failure. New tests have begun to determine the effect of a higher number of start/stop cycles. The actuator room is being outfitted as it sits on the ground awaiting completion of the structure. The basic mechanical and electrical equipment are installed, but the electronics will be added after the building is on the telescope and properly climate controlled.

W. H. PORTER

## AVAILABILITY AND TESTS OF A NEW GBT 12-15 GHZ RECEIVER FOR THE 140 FOOT TELESCOPE

A recently completed Ku-band receiver has been mounted at the Cassegrain focus of the 140 Foot Telescope and is now available for general use. The receiver, which replaces an older cooled HFET receiver, is intended to be moved to the GBT once the new telescope is finished. Until then, we will keep the receiver mounted on the 140 Foot, thereby allowing observers to quickly switch between this receiver and the two other receivers mounted at the Cassegrain focus.

The receiver uses the GBT receiver design and consists of dual circularly-polarized channels with cooled HFET amplifiers. The receiver covers from 12.0 to 15.5 GHz, somewhat less than the 12-18 GHz coverage of the receiver it replaces. Because of hardware limitations in the I.F. system at the 140 Foot, the instantaneous bandwidth is 300 MHz, much smaller than what we will have when the receiver will be used on the GBT. Except for some simple hardware switches, the receiver requires no tuning over its complete frequency range.

Preliminary tests, although not very extensive, suggest that the performance of the receiver is exceptional. The shape of the bandpass looks very good and users should expect excellent spectral-line baselines. Initial observations indicate that on typical cold winter days the zenith system temperature throughout the covered frequency band should be about 30 K. This is some 10 to 20 K lower than the performance of the receiver that was used to cover this band. Additionally, the receiver is by far more user-friendly than the replaced receiver. Note that the new receiver's system temperatures are 5 to 8 K higher than we expect for the GBT because of the contribution of scatter off the 140 Foot feed legs.

At the end of January we intend to make more tests, some of which will be designed to confirm noise tube values and these excellent system temperatures. Regardless of the outcome of the tests, observers should expect that they will use the new receiver for all Ku-band observations.

R. J. MADDALENA

# VLBA/VLBI

## VLBA STATUS

In the last trimester of 1994 (actually until December 20), we successfully correlated 60 VLBA projects (including 11 VLBA tests). This is up about 50 percent from the corresponding number (43) of the preceding trimester. Despite our success at increasing the operational efficiency of the correlation, there remains much to be done in improving throughput. Scrutinization of the data continues to be excessively time-consuming, even with the advent of a stand-alone data "sniffer" that does not require loading the data into AIPS.

The backlog of global projects to be correlated continues to be attacked. Huib van Langevelde (EVN Visiting Scientist at the AOC) oversees the processing of observations from the queue. Processing continues to be labor intensive compared to VLBA processing. Despite this, we have correlated fourteen projects in the last trimester. The priority is to work backwards through 1994 (12 projects remaining) and then into 1993 and 1992 (42 projects). In doing so, we will exclude those observations that are not within our current capabilities for correlation. Neither sub-arraying nor tape stopping and starting are currently supported in the correlator software.

The rewrite and redesign of the correlator code continues but has been slowed by a new bug affecting correlation of experiments at speed-up factors greater than two. In this effect, fringes would disappear in the middle of a correlation job. After much detective work, mainly by the software group, this was discovered to be due to a loss of precision in various phase calculations. A number of fixes to allow correlation are either in place now to allow correlation or are being developed for the longer term.

In the first quarter of 1995, we will take delivery of the final 280 thin tapes that were planned as part of the VLBA construction. These will be placed in use as soon as possible. Based upon the recent progress in improving correlation efficiency, the observing rate will be increased by about 30-40 percent in the first quarter. The time allocated in the first four months will be 1420 hours (up from 1060 hours for the last trimester of 1994) for about a 50 percent observing duty cycle.

T. J. CORNWELL

## VLBI NETWORK CALL FOR PROPOSALS

Proposals for VLBI network observing are handled by the NRAO. In particular, the network sessions for 1995 are expected to be as follows:

| Session | Dates | Bands | Proposal Deadline |
|---|---|---|---|
| 1 | 11 Feb to 24 Feb | 0.7, 3.6/13, 90 | 1 Oct 1994 |
| 2 | 03 May to 24 May | 6, 18/21, (50) | 1 Oct 1994 |
| 3 | 04 Oct to 01 Nov | 1.3, 6, 18/21 | 1 Jun 1994 |

The EVN program committee has indicated that they will accept proposals for EVN-only observation and correlation for the May session up to a February 1 deadline. VLBA-only proposals submitted for the February 1 deadline will be scheduled after June 1.

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 Joanne Nance (804-296-0323; jnance@nrao.edu).

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 amount of 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 EVN even 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 für Radioastronomie
Auf dem Hugel 69
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

# VLA

## VLA CONFIGURATION SCHEDULE

| Configuration | Starting Date | Ending Date | Proposal Deadline |
|---|---|---|---|
| DnC | 13 Jan 1995 | 20 Feb 1995 | 03 Oct 1994 |
| D | 24 Feb 1995 | 05 Jun 1995 | 03 Oct 1994 |
| A | 23 Jun 1995 | 04 Sep 1995 | 01 Feb 1995 |
| BnA | 15 Sep 1995 | 02 Oct 1995 | 01 Jun 1995 |
| B | 06 Oct 1995 | 08 Jan 1996 | 01 Jun 1995 |
| CnB | 19 Jan 1996 | 05 Feb 1996 | 02 Oct 1995 |
| C | 09 Feb 1996 | 15 Apr 1996 | 02 Oct 1995 |

The VLA currently is scheduling two large surveys. One will be done at nighttime in the DnC and D configurations ($01^h$-$16^h$ and $06^h$-$20^h$, respectively, for the 1995 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 |
|---|---|---|---|---|
| 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. The D configuration daytime will be about $00^h$ RA and the A configuration daytime will be about $07^h$ 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

## VLA DATA ARCHIVE UPDATE

"VLASORS," a program for IBM PC compatible computers is available. It allows the user access to a list of all sources (excluding calibrators) observed with the VLA. Information on observing frequency, position, modes, proposal code, observer, number of antennas, total observing time, and other details about proposals are available through the program.

Included are observations up to the end of 1993. The user can search by source position, source name, and a few other parameters. Only observations longer than ten minutes are in the database. In addition, the program allows the user to search the standard VLA calibrator list by position and name.

The current version of the program and data can be obtained from the anonymous ftp area zia.aoc.nrao.edu, sub-directory "pub/vlasors," on Zia at the AOC. Alternately, you may request the update on 3.5" (high density only) floppy. Contact Lori Lappel (lappel@nrao.edu) or L. Lappel, NRAO, P. O. Box O, Socorro, New Mexico 87801. In addition, available on anonymous ftp at the AOC in the subdirectory "pub/vlaarchive" are text versions of this archive and proposal information.

R. C. BIGNELL

## VLA 7 MM SYSTEM STATUS

The VLA 7 mm (Q-band) system is fully operational and is regularly used by observers. Nighttime observations in good weather have rms phase variations of ~20 degrees or less and an rms noise in one hour of on-source integration of ~1 mJy/beam using two IFs of 50 MHz at 43.4 GHz. Under poor conditions the rms may be 2-3 times worse. During the daytime, and especially during changing weather conditions, there can be a total loss of phase coherence. For complete details on the system and its performance, see the Observatory Status Report and VLA Technical Memo #189. To obtain a status report with recent 7 mm news, e-mail dwood@nrao.edu.

In the current C configuration, the 10 Q-band systems are located in the inner three stations of the array with the tenth system on the fourth station of the north arm. For the next DnC and D arrays, the 7 mm receivers will be located at the following stations:

| Antenna | DnC | D |
|---|---|---|
| 4 | E1 | E1 |
| 22 | E4 | E4 |
| 16 | E7 | E7 |
| 14 | N4 | N1 |
| 13 | N2 | N3 |
| 25 | N6 | N6 |
| 27 | N8 | N8 |
| 3 | W2 | W2 |
| 1 | W5 | W5 |
| 8 | W8 | W8 |

This "spiral" pattern produces a more uniformly sampled u-v plane than the previous configuration. The spiral also avoids some time lost due to shadowing. With this configuration operating at 43.4 GHz, a 12-hour synthesis of a source at 45 degrees declination in the D array produces a synthesized beam of 2.2 x 1.5 arcseconds with no sidelobes above ten percent. The AIPS task UVSIM can make these predictions for your particular observation.

With the installation of the tenth system and the arrival of winter weather, line observations are now becoming more routine. The nominal receiver range is 40 to 50 GHz, with five times worse performance at 49 GHz than at 43 GHz. SiO J=1-0 ,v=0, and v=1 lines (43 GHz) have been detected by D. Wood, $HC_3N$ J=5-4 (45 GHz) has been observed by A. Wootten *et al*., and most recently D.Wood and C. Chandler imaged the CS J=1-0 (49 GHz) emission of the IRc2 region.

If you have Q-band time scheduled, you must obtain the latest version of OBSERVE to prepare your observe file. Feel free to contact me in advance of your observations for advice on observing strategy.

D. O. S. WOOD

## VLA UPGRADE SCIENCE WORKSHOP

In the nearly fifteen years since the Very Large Array was commissioned, major technical improvements have been made in receiver components, correlator design, and the transmission of broadband signals, rendering many elements of the VLA obsolete. Furthermore, many components are becoming increasingly vulnerable to failure and are increasingly difficult to repair or replace. A major upgrade to the VLA is therefore very much needed, but not just to avoid instrument degradation. The intent of the upgrade is to take advantage of available technology to greatly enhance its performance, making possible new science.

Planning has commenced for a significant upgrade to the VLA. As presently conceived it has three key elements: (1) replace most of the VLA receivers to achieve lower noise temperatures and a much wider bandwidth (1 GHz in each polarization) and add two new observing bands; (2) replace the buried waveguide data transmission system with a fiber-optics system; (3) design and construct a new correlator to process both broadband continuum signals and to provide improved resolution and flexibility for spectral line work. Also under discussion are the possibilities of adding additional low-frequency receiver systems at the prime focus, of supporting an ultra-compact antenna configuration for imaging low-surface-brightness objects, of a fiber-optic link to the Pie Town VLBA antenna, and of eventually adding up to four antenna elements to fill in the gap between the VLA and the VLBA.

Because the Upgrade will be defined and justified by the science it enables VLA users to accomplish, the NRAO will host a VLA Upgrade Science Workshop at the Array Operations Center in Soccoro, New Mexico, on 13-15 January 1995. The workshop will be modeled after the MMA science workshops, wherein a

comprehensive scientific case was formulated for the instrument by several science working groups.

In the present case, the VLA upgrade science working groups are:

1. Solar system: Sun, planets, minor bodies, radar, IPM.

2. Galactic I: Pre-MS, MS, and post-MS stars, planetary nebulae, CVs/XRBs, SNRs, pulsars, propagation.

3. Galactic II: Galactic center, ISM, HI, star formation, H-H objects, masers, classical and ultra-compact HII regions, astrochemistry.

4. Extragalactic I: Normal galaxies (continuum, HI, RRLs, masers), extragalactic RSN, clusters.

5. Extragalactic II: AGN, radio galaxies, high-Z objects, high-Z HI and CO, S-Z effect, lensing, source counts.

At present, approximately 30 external scientists have indicated an interest in participating. While more can be accommodated, they should make arrangements to attend as soon as possible. They may do so by contacting tbastian@nrao.edu.

T. S. BASTIAN, R. A. SRAMEK, AND R. A. PERLEY

## FIRST RESULTS FROM THE VLA FIRST SURVEY

The FIRST survey is now producing its Faint Images of the Radio Sky at 20 cm using 625 hours of data collected over the past 18 months at the Very Large Array. The primary objective of the survey is to produce an image of the radio sky covering the 10,000 $deg^2$ of the North Galactic Cap coincident with the Sloan Digital Sky Survey (SDSS). The peak flux density threshold is <1 mJy, the angular resolution is 5", and all ~1 million sources in the survey catalog will have positions accurate to better than 1". Data were collected in the B configuration in the spring of 1993 and during the summer of 1994.

All the 1993 data have now been self-calibrated, mapped, CLEANed and coadded to produce 1039 images 46.5' x 34.5' in extent with a 1.8" cell size. The region covered comprises a strip of sky bounded by $7^h\ 15^m$ < RA(2000) <$16^h\ 30^m$ and 28.5 < dec (2000) < 31.0. More than 97 percent of the images achieve an rms noise level of <150 μJy/beam; they display a surface density of ~ 100 sources $deg^{-2}$ down to a peak flux density threshold of 0.75 mJy. A preliminary catalog containing 28,000 radio sources has been constructed from the images.

Each coadded image overlaps with its nearest neighbor in both RA and Dec. The rectangular shape of the images is a reflection of the uneven spacing grid of the survey in RA and Dec. In fact, the grid of pointings is so closely packed in declination (at this particular declination) that we need only produce a coadded image for every other dec strip to cover the sky without gaps. The images are named by their central coordinate as hhmmm ± ddmmm.

Extensive astrometric and photometric tests have been performed on the 1993 images. We find, from a comparison with the Merlin calibrator list, that our absolute astrometric accuracy is good to better than 0.05". From both comparison of sources appearing in multiple overlapping images and from a direct comparison of over 4500 sources with their optical counterparts in the APM catalog of the POSS I plates, we derive 90 percent confidence error circles of <1" for even the weakest sources in the survey. The flux densities of sources are systematically underestimated owing to "CLEAN bias" by ~0.2 mJy for point sources and by larger amounts for extended objects. A detailed description of our data analysis pipeline and the verification procedures we have performed on the output images can be found in the FIRST introductory paper available from our home page (see below).

The FIRST survey team consists of Robert Becker (UC Davis and IGPP, Livermore), David Helfand (Columbia), Richard White (STScI), Rick Perley (NRAO), and Michael Gregg (IGPP). A home page for the survey has been installed on the WWW; the URL address is http://sundog.stsci.edu/top.html. Anyone interested in the current status of the survey, a detailed description of the observations and their analysis, and instructions for accessing all survey data products should consult the home page.

Consistent with our original proposal to the NRAO, there is no proprietary period for FIRST observations; the raw u-v data are available from the VLA archive the day they are taken. In addition, we are providing to the community a complete edited and self-calibrated u-v data set, the individual pointing maps, the coadded image set, a catalog of detected sources, and “postage stamp” images of each source as soon as they are verified. All of the self-calibrated data from both observing seasons are now available, as are the pointing maps, coadded images, and a preliminary catalog for the 1993 data. Query the home page for access to these data and for a schedule of future releases.

NRAO will be making the images and calibrated u-v data available via anonymous ftp in January 1995, once appropriate arrangements can be completed. Check the NRAO WWW Home Page (http://www.nrao.edu) for details.

R. BECKER, D. HELFAND, AND R. WHITE

## COMPUTING AT NRAO-NM

In the January 1994 Newsletter, we announced the creation of an alias for the AOC anonymous ftp site, ftp.aoc.nrao.edu. In early 1995, the ftp location will move off zia.aoc.nrao.edu. After this time, only the ftp.aoc.nrao.edu address will work for retrieving files from the AOC via anonymous ftp (an informational notice will be printed if you do use the old address instead).

Because of the earlier delays in the migration of the majority of AOC Suns to the Solaris 2 operating system, it now makes sense to wait for the forthcoming release, 2.4. We expect to receive this in mid-December, and we plan to install it as soon as it arrives. Migration of most Suns should begin in earnest soon after that. Solaris 2.4 has significant performance improvements which will benefit in-house staff and visiting observers alike.

Realtime data filling at the AOC has become a widely used method of having the data available immediately after observations end. Some remaining problems were straightened out in the past quarter. Visitors who are interested in using this mode of observing should contact gvanmoor@nrao.edu.

There were two personnel changes in the VLBA online group. We welcomed Kevin Ryan, who joined the group in August as a Scientific Programming Analyst, and in December we were sorry to have to say farewell to Terri Bottomly.

The tape archiving project, in which all VLA data are converted to the current data format and copied to Exabyte tape, has made excellent progress. To date all observations from 1976 to 1983 have been converted, plus all observations from 1993 and 1994; currently 1992 is in the process of being archived. Simultaneously an ever-growing database containing essentially all header information is being constructed. A program which allows users easy access to this database is in the final testing stage, and we hope to announce its availability shortly.

G. A. VAN MOORSEL

## FIFTH NRAO SYNTHESIS IMAGING SUMMER SCHOOL

The Fifth NRAO Synthesis Imaging Summer School will be held in Socorro, New Mexico from June 5-9, 1995. This edition of the summer school will break from the tradition established in the last two, and be held between Monday and Friday. A data reduction tutorial will be held on Monday and Tuesday evenings (June 5 and 6) and on Wednesday, June 7 to allow attendees to get "hands-on" experience with data calibration and imaging for both VLA and VLBA data.

The Summer School will cover all basic aspects of radio interferometry, including both connected element "VLA" and "VLBI" interferometers. Lectures will be given by NRAO staff on topics ranging from principles of coherence to detailed techniques of image formation and deconvolution. The range of subjects will be the same as in past Summer Schools, and can be reviewed by consulting Synthesis Imaging in Radio Astronomy, the published collection of lectures from the 3rd NRAO Synthesis Imaging Summer School (ASP Conference Series, Volume 6, 1989). This volume has recently been reprinted, and can be ordered from the Astronomical Society of the Pacific, (415) 337-1100. It is recommended that participants have a copy of this book.

There will be no limit to attendance. A fee of $35 will be assessed, sufficient to cover only our local expenses. NRAO will provide free transportation to and from the Albuquerque airport on June 4, June 9, and 10. We have reserved dormitory rooms (mostly doubles) at New Mexico Tech for the week of the summer school. The cost is $15 double, and $18 single, per person, per night. Friday and Saturday night stayover is possible following the meeting. **Note: Early arrivals cannot be accommodated in the dormitories**. A list of Socorro motels will be sent to those preferring individual accommodation. Motel registration is the responsibility of attendees.

A non-refundable, full campus meal ticket, covering all meals from Monday to Friday, inclusive, is available for $50. Individual meals can be purchased for $4, $4.50, and $5, for breakfast, lunch, and dinner, respectively. For those interested in dining out, a list of Socorro restaurants will be sent to registrants. A summer school dinner, held outdoors on the New Mexico Tech campus, on Wednesday evening will be free to participants.

You may register for this meeting by filling out the accompanying registration form, and mailing it by April 1, 1995 to: Terry Romero, NRAO, P.O. Box O, Socorro, New Mexico 87801, or fax to T. Romero (505) 835-7027.

Organizers

Lectures: Rick Perley, e-mail: rperley@nrao.edu

Arrangements: Terry Romero, e-mail: tromero@nrao.edu

R. A. PERLEY

## VLA/VLBA PROPOSAL INFORMATION

We recommend electronic submission of VLA and VLBA proposals. The experience with e-mail proposals over the last year has made this form of submission very reliable, with fast response from NRAO upon their receipt. This is in contrast to proposals sent by postal carriers which can be unexpectedly delayed, sometimes arriving in Charlottesville past the deadline. If you do send your proposal to NRAO by a postal carrier, please allow sufficient time for delivery. Experience shows one week is insufficient.

The proposals, in Adobe Postscript format, should be sent by e-mail to propsoc@nrao.edu . The deadline (the time when they are received in the propsoc@nrao.edu account) is the same as that for paper copies. To be acceptable, these postscript files must be printable on our printers; first time users (and all cautious users) should submit their proposals well before the deadline to allow time for interation if your first version will not print properly. You will then receive an acknowledgement of the receipt of the proposal (and its status) within one working day.

For the October 3, 1994 deadline, more than 90 of the 235 VLA/VLBA proposals were submitted by e-mail. Most of these were successfully printed on the first try. Some of the problems were caused by the assumption of DIN A-4 paper in our printer which resulted in pages that were chopped at the top. Please remember that our printers use the standard US paper (8.5" x 11.0"). Another problem can occur when separate postscript files are concatenated to form the entire proposal. Do not place any non-postscript text between the files because this will cause printing errors. Also, it is simpler if the entire postscript file is sent in one e-mail message. More information is given on the World Wide Web.

To help simplify the proposal process, please observe the following. Contact Joanne Nance at (804) 296-0323, (jnance@nrao.edu) for information about the receipt of a proposal mailed to Charlottesville. Contact Lori Appel at (505) 835-7310 (lappel@nrao.edu) if there are any questions concerning an e-mail submission. Please send only one copy of your proposal to NRAO, unless requested to do otherwise. Unanticipated multiple copies of proposals by e-mail and surface mail cause confusion.

Cover sheets are available as before via anonymous ftp from ftp.cv.nrao.edu. Both TeX template and postcript file are available with the command "get" after changing directory with the command "cd proposal" (see the file "instructions" in that directory).

E. B. FOMALONT

## ASSISTANCE FOR VISITORS TO THE AOC

Providing adequate notice of your visit to the NRAO staff will ensure that all necessary arrangements are made for a successful visit. A two-week notice is preferable although a one-week notice is acceptable. The more advance notice given for a visit the better chance of getting 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 is helpful 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.

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.

The levels of assistance available from AOC staff are:

**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: (a) inexperienced users new to synthesis imaging; (b) infrequent visitors whose experience is out of date; or (c) those requiring minor consultation on technical matters.

**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.

**Reservations:** Reservations for a visit are made by contacting Eileen Latasa at: e-mail: elatasa@nrao.edu, phone: (505) 835-7357, or fax: (505) 835-7027.

M. T. ROMERO

# 12 METER

## FURTHER DEVELOPMENTS IN SPECTRAL LINE ON-THE-FLY MAPPING

Spectral line on-the-fly (OTF) mapping continues to mature at the 12 Meter Telescope. As explained in past Newsletters, the OTF mapping mode acquires spectra at a rapid rate (10 times/sec) taken as the telescope is scanned continuously across the field. Each spectral sample is tagged with the actual telescope encoder position; a regular grid is produced in the analysis stage in a procedure analogous to UV gridding of synthesis data. The advantage of this observing technique is that an entire imaging field can be scanned rapidly with low overhead, thereby minimizing systematic changes in atmospheric and instrumental responses.

The two largest challenges we have faced in implementing this technique are in coping with the high data rates (~1 MByte/minute) and in developing analysis tasks that can be run in quasi-real time at the telescope. In recent weeks we have acquired a single-processor Sun Sparc 20 workstation that has significantly sped up analysis. We have also obtained a 10 GByte disk drive for AIPS analysis use and have about 3 GBytes of raw data storage space. The disk storage situation has been eased, although observers must still compress their raw data files and must diligently delete unneeded intermediate analysis files. The Classic AIPS tasks used for OTF analysis have been streamlined and a few bugs have been fixed in both the control and analysis procedures. OTF data processing still requires a considerable investment of time and work, but the job is becoming faster and more pleasant. Observers not already familiar with AIPS must become so.

The benefits of this technique have already been realized. Observers are producing interesting images of several sources that are of higher quality and cover larger fields more quickly than have ever been possible before. A sample image of DR21 is shown in the plot on page 12. This technique can be used with any of the dual-polarization receivers at the 12 Meter; images at 3 mm, 2 mm, and 1.3 mm wavelengths have been made this season. The data can be taken with any of the filter bank spectrometers, but not yet with the Hybrid Spectrometer. We are working on supporting this mode with the Hybrid Spectrometer which will allow OTF observing with the 1.3 mm eight-feed receiver. Continuum OTF mapping is also supported.

J. G. MANGUM, P. R. JEWELL, AND D. T. EMERSON

## E-MAIL SUBMISSION OF 12 METER TELESCOPE OBSERVING PROPOSALS

Observers now may submit their 12 Meter observing proposals by e-mail. Traditional hard copies continue to be perfectly acceptable. For e-mail submission, the entire proposal, including cover sheet, text, and figure(s), must be in a concatenated Postscript file. E-mail this single Postscript file to proptuc@nrao.edu. Complete instructions are given from the NRAO Home Page on the WWW under “Tucson, Observing Proposals.” For general questions on the 12 Meter and proposal preparation, contact Phil Jewell in Tucson (pjewell@nrao.edu). For questions regarding the submission and receipt of e-mail proposals, contact Carolyn White in Charlottesville (cwhite@nrao.edu).

P. R. JEWELL

## IAU SYMPOSIUM 170 1995 MAY 29 - JUNE 2, TUCSON, ARIZONA “CO: TWENTY-FIVE YEARS OF MILLIMETER-WAVE SPECTROSCOPY”

Preparations are proceeding for IAU Symposium 170. This symposium will commemorate 25 years of millimeter-wave spectroscopy of carbon monoxide and other molecules, review recent research in the field, and will look ahead to future research and instrumentation. The symposium will be held from 1995 May 29 to June 2, in Tucson, Arizona, at the Loews Ventana Canyon Resort. Registrations, including titles for contributed talks, and requests for IAU travel support are being accepted now. General information and registration forms may be requested by e-mail at symp95@nrao.edu or viewed on World Wide Web: go to the NRAO Home Page, click on Tucson, then on Information for "CO: 25 Years . . .". Specific questions may be addressed to LOC Chair Bill Latter (wlatter@nrao.edu) or Darrel Emerson (demerson@nrao.edu).

W. B. LATTER, D. T. EMERSON, AND P. R. JEWELL

Figure Caption

Integrated intensity image of the $H_2CO$ 1(01)-0(00) (72.409092 GHz) transition toward the DR21/DR21(OH) star formation region. This map was acquired by combining 3 maps of a field 7' X 20' in extent. The row spacing used for each map was 25", while the spectrometer used for the image shown consisted of two banks of 128 100 kHz filters sampling signals of orthogonal polarization. A total of approximately 2.25 hours of telescope time were used for these measurements. Processing time for this image was about 0.5 hours using the new Sparc 20 at the telescope. The three main components of $H_2CO$ emission in this image are DR21 (at 42d 09m), DR21(OH) (at 42d 12m), and DR21(FIR) (at 42d 14m). The grey scale flux range is from 0 to 13.5 K-km $s^{-1}$, with contour levels at 2, 4, 6, 8, 10, and 12 K-km $s^{-1}$.

# Fifth NRAO Synthesis Imaging Summer School

Socorro, New Mexico
June 5-9, 1995

**Please return by April 1, 1995 to:**

Terry Romero
National Radio Astronomy Observatory
P. O. Box 0
Socorro, NM 87801

Fax: 505-835-7027
E-mail: tromero@nrao.edu

**Do not send money with this form; invoices will be included in the next mailing. If there are any subjects you wish to have discussed, please list them or e-mail rperley@nrao.edu.**

Name: _____

Address: _____

_____

Phone: _____ Fax: _____

E-mail: _____

If your address during April/May is different than above, please indicate that address along with applicable dates.

**Check one:**

( ) I definitely plan to attend.
( ) I hope to attend and will confirm later.

**I wish to attend:**

( ) All 5 lecture days, June 5-9.
( ) The Data Reduction Tutorial, June 5-7.

**Please indicate your profession level:**

( ) Undergraduate
( ) Graduate Student
( ) Postdoctoral
( ) Scientific or Engineering Faculty/Staff
( ) Other

**Have you observed with:**

**VLA** ( ) Yes ( ) No
**VLBA** ( ) Yes ( ) No

**Please reserve dormitory accommodation for me as follows:**

( ) Single room, no meals.
( ) Single room and full campus meal ticket.
( ) Double room, no meals.
( ) Double room and full campus meal ticket.

**I requested a double dormitory room, and I want to share it with:**

( ) A specific person (_____).
( ) Any male.
( ) Any female.

**I intend to stay in a motel:**

( ) I want a full campus meal ticket.
( ) I will purchase some campus meals individually.