NRAO NEWSLETTER

1 January 1996 No. 66

GREEN BANK

GBT NEWS

Construction activity has moved ahead at the Green Bank Telescope site over the last quarter, although at a slightly slower pace owing to a couple of factors. First, the derrick crane went out of service in October due to a broken sheave (pulley wheel around which the cable is wrapped). This was not an easy fix for COMSAT RSI; it involved engineering design, special parts order, and a significant disassembly/installation/re-assembly effort over about two months. Fortunately, work was able to proceed using the traveling cranes on the ground. More recently, the second factor affecting progress has been the winter weather.

In spite of these hindrances, obvious progress has been accomplished. A photograph of the structure in early November is shown on the next page, and much has been achieved even since the photo was taken. On the structure, the elevation wheel has been completed and sixteen counterweight boxes (out of 22 total) have been installed on the wheel. The boxes are approximately 14 ft x 8 ft x 8 ft and weigh about 25, 000 pounds each when empty, so installation is not trivial. Ultimately, the boxes will be filled with concrete to counterbalance the structure with a weight of approximately 2 million pounds. Also, the front center truss of the rotating box has been put into place, following completion of the rotating box trial erection on the ground. All eight elevation gear reducers have been installed. All access lighting on the alidade is now in place and working. In addition, the lower elevation cable wrap junction box has been installed and the cables have been pulled from level one.

On the ground, work has continued on the back-up structure (BUS) trial erection. The R_0 truss (center truss) from hoop 15 to 33 is in place. The R_{1R} and R_{1L} (Ribs 1 right and 1 left of center) trusses are in place from hoop 27 to 33, and R_{2R} and R_{2L} are in place from hoop 15 to 33. For reference, there are 57 ribs total (the center rib plus 28 right and left). This is a major part of the current site work and will continue into the summer. Disassembly of the BUS and installation on the structure is scheduled for next fall. And, eight concrete foundation pads have been built to support the trial erection of the upper feed arm scheduled for next month.

Fabrication and assembly of the subreflector (an ellipsoid 7.55 m x 7.95 m) is proceeding at COMSAT RSI's Sterling, Virginia plant. Twenty-eight of the 40 panels have been fabricated and measured and are being installed on the subreflector back-up structure. The assembled unit is scheduled to be shipped to Green Bank in February. In addition, fabrication, measuring, and painting of the 2,000 main reflector panels continue at Sterling. At the Dallas plant, the GBT feed arm servo hardware is undergoing system integration. The system will be ready for in-house tests in late January and shipment to the site in February.

The next quarter promises to be exciting as the box structure and horizontal feed arm erection continues, the trial erection of the back-up structure progresses, and the integration of the upper feed arm, subreflector, and servo system occurs.

W. H. Porter

GREEN BANK 20-METER TELESCOPE BACK ON LINE

The new 20-meter RSI telescope, built for the USNO geodetic VLBI program, is back in regular operation. One of its angle encoders was on loan to the VLBI station in Kauai, Hawaii, which has a similar antenna, from about March to October. The long down time could have been prevented had we had a spare encoder, but due to a tight USNO budget, no spares were on hand. The 20-meter will be used about 30-50 hours a week for geodetic VLBI. The control computer, a NASA "field system," has recently been upgraded to allow observing in many of the VLBA observing modes as well as the usual Mark 3 modes.

F. D. Ghigo

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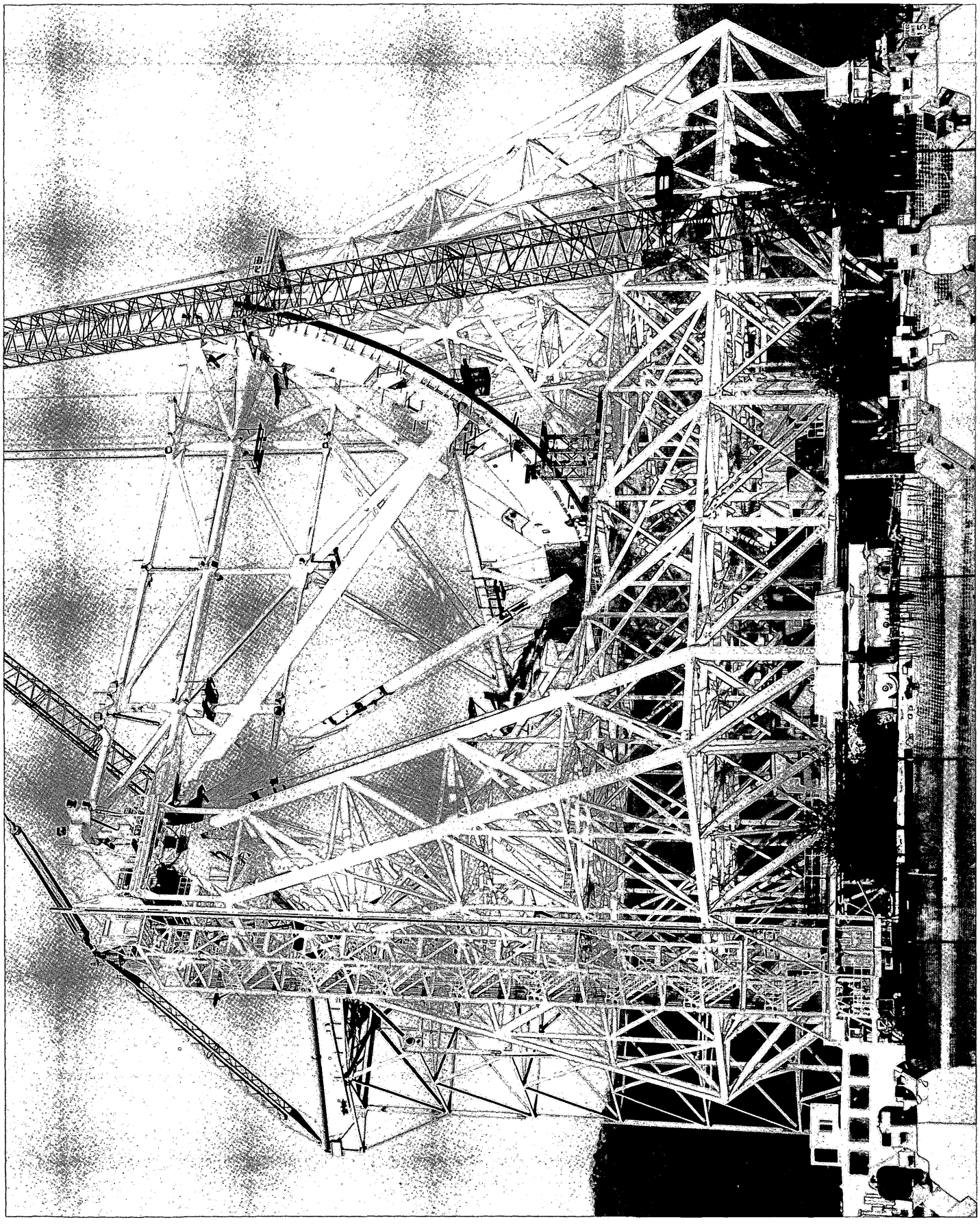

THE 140 FOOT IN 1996

During the coming year the 140 Foot Telescope will continue to operate as a general purpose user facility but with a few changes.

In early spring several days will be set aside in order to use the telescope for extensive tests of the complete GBT electronics path, from the local oscillator through the backend. The telescope will be controlled with GBT software, and observations will be made that test Doppler tracking and frequency switching. Later in the year the telescope will participate in expanded tests of the GBT electronics as well as a dry run of the GBT holography system.

Because the same people that support observations at the 140 Foot are involved in GBT development, in 1996 we will be taking extra care to minimize conflicts between the two activities. What this means in practice is that receiver changes at the telescope will be less frequent than they are now, and the telescope will be scheduled further in advance. We currently schedule the telescope one month at a time, with observers being given at least one month's notice before their observations. In 1996 we will begin scheduling up to three months ahead. This will reduce our ability to respond to new proposals quickly, but we still hope to retain some flexibility.

The GBT Cassegrain receivers will be available at the 140 Foot all year. The K-band receivers have been upgraded with new HFET amplifiers from the Central Development Lab. Recent tests of the 22-26 portion of the K-band system by Ron Maddalena have given excellent results. In very good weather, the system temperatures have been in the range 35-55 K, with the best values occurring near 22 GHz.

F. J. Lockman

NRAO OVLBI EARTH STATION MILESTONE ACHIEVED

In preparation for the launch of the Orbiting VLBI satellite VSOP by the Japanese Space Agency, ISAS, in September 1996, the NRAO Tracking Station in Green Bank is conducting a series of tests of the station capability. In normal operation, Green Bank and other tracking stations will transmit an uplink timing tone to the satellite, and the satellite will sample astronomical signals and transmit data back to the tracking stations. The tracking stations will record the data on wideband magnetic tape and send it to the VLBA or other correlator. The tracking station will also track the phase of the downlink signal (Doppler tracking) in order to measure timing corrections for the correlator and for determination of the satellite orbital parameters.

A JPL/Caltech test transponder, called Surfsat, was attached to the third stage of a Delta Rocket launched in early November 1995. The transponder downlink signal was tracked at Green Bank soon after launch, but establishing a two-way link to Surfsat proved much more difficult.

On Friday, 1995 December 15, at 21:29:42 UTC, the NRAO OVLBI Earth Station achieved two-way lock to the Surfsat spacecraft for the first time. This was accomplished while Doppler tracking both the uplink and downlink in accordance with the predicted orbit supplied by Mark Ryne of the JPL navigation team the previous day. The residual phase of the two-way link was measured and recorded at 0.1 sec intervals using the same hardware and software that will do so during VSOP/Radioastron tracking.

G. I. Langston and L. R. D'Addario

12 METER

TUCSON STAFF CHANGES

Phil Jewell, Deputy Assistant Director for Tucson Operations, left NRAO at the end of 1995, to become Head of Instrumentation at the James Clerk Maxwell Telescope in Hawaii. Phil has supported the 12 Meter Telescope for more than a decade; his departure is a great loss to NRAO and to the many 12 Meter observers who have benefited from Phil's experience and advice. We wish Phil all the best in his new job, and look forward to continuing scientific and technical collaborations.

Jeff Mangum joins NRAO as the new Friend of the Telescope for the 12 Meter. Jeff had been a Junior Research Associate with NRAO from 1989-1990, and since 1992 has been Friend of the Telescope for the Submillimeter Telescope Observatory (SMTO) of Steward Observatory at the University of Arizona. Jeff has already contributed to the implementation of the on-the-fly observing technique now popular at the 12 Meter and is an experienced observer at the 12 Meter.

D. T. Emerson

EIGHT-BEAM RECEIVER NEWS

Construction of the eight-beam, 1.3 mm array receiver has been finished. The receiver is currently undergoing telescope and laboratory testing. The completed multi-beam receiver was installed on the telescope for a brief set of tests on December 19-21. Beam-shapes and aperture efficiencies were good, and spectral line detection of the 230 GHz CO line appeared correct. Beam maps were made using the spectral line on-the-fly observing technique by observing a planet through the spectrometer system. Low-level software for controlling the rotator was installed, tested, and functioned properly. High-level software for entering user rotation offsets and for tracking parallactic angle is in progress. A problem with receiver noise temperatures remains at this writing. As measured through the receiver, noise temperatures are about 50 percent higher than can be accounted for based on measurements of the mixers in a simple test dewar. The engineering staffs in both Tucson and Charlottesville are investigating this problem. In addition, the Central Development Lab in Charlottesville is working to supply uniformly good mixers for all eight of the feeds.

Several more test sessions are planned for January and February, during which 8-beam observing modes will be further developed and the receiver performance will be further quantified. We expect that the principal observing mode with the 8-beam will be on-the-fly observing. Automated tuning of the mixers will be implemented in the spring. In brief, the eight-beam receiver will have a tuning range of approximately 215 to 250 GHz. The array is in a 2x4 rectangular configuration with each beam separated by 87". The array can be rotated to any angle and can track parallactic angle.

P. R. Jewell, D. T. Emerson, and J. G. Mangum
for the Tucson and Charlottesville Receiver Groups

VLBA/VLBI

VLBA STATUS

During the fourth quarter of 1995 (period ending December 18, 1995), a total of 78 projects was correlated (62 VLBA, 11 tests, and 5 global), a significant increase over the previous quarter. This brings the total number of projects correlated and released so far in 1995 to 260. This is a major achievement, and I want to take this opportunity to express my thanks to all those people within NRAO who have contributed towards the success of the VLBA.

Recently the correlator underwent a major software upgrade. This is the primary reason for the increase in efficiency. A major part of the update was the release of a new correlator job generator with a high level of automation. This requires less human interaction than before. Another major aspect was improvement in the software infrastructure in preparation for Space VLBI and subarraying. These changes have resulted in improved reliability of the correlator software. Several new features also were implemented, and the guidelines for VLBA observing were revised to reflect them. The guidelines are available on the NRAO WWW home page.

One major problem area that had been affecting observations was a subtle bug in the VLBA formatter that caused the 16-track barrel roll to fail, resulting in loss of data. A major effort on the part of Ron Weimer and George Peck, of the Electronics Division, solved this problem.

P. J. Diamond

STATUS OF VLBA OBSERVE

On October 31, 1995, a review of the VLBA Observe (or GNOMES) project was performed. As a result, it was decided to halt all further work on the project. There were several reasons behind this difficult decision: (1) it was evident that the initial aims of the project were too ambitious; (2) the current prototype would have required great effort to produce a version that could be used outside of NRAO; (3) we are faced with the prospect of Space VLBI and Mk4 recording sometime next year and require working software to schedule such observations.

In order to serve the needs of the VLBI community, NRAO's limited resources will be concentrated on implementing the necessary changes in SCHED, the program currently used to schedule the VLBA. Since this decision was made, much work has been done on SCHED. The next release (currently being tested) will have u-v and sky coverage plotting, dwell time scheduling, and major internal restructuring in preparation for reading and writing Mk4 VEX format files. In addition, the manual has been rewritten and will be available in postscript and html versions from the NRAO WWW home page. Planning is underway to solve the long-term scheduling needs of both the VLBA and VLA.

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 U.S. 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).

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 Betty Trujillo, 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 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
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

VLA

VLA CALIBRATOR MANUAL UPDATED

The VLA calibrator manual has been updated. Just over 200 sources have been added to the manual, bringing the total number of calibrators to 1015. New entries have been added to nearly 200 existing calibrator sources, and a few significant position errors have been corrected (namely for J1206+642 and the B1950 position given for J0014+612). Documentation for the calibrator manual also has been updated and made somewhat easier to access on the WWW at http://www.nrao.edu/~gtaylor/calib.html. Some new features have been added to this hypertext version of the calibrator manual. Links are provided to 378 maps and visibility plots. These plots may be useful for deciding on the appropriateness of a calibrator for a given observation in addition to the u-v limits that are provided. A search engine for the calibrator database accessible via the WWW is under construction and should be available in the first quarter of 1996.

The revised calibrator database is accessible via the VLA Information System (vlais) under the VLA specific menu. The revised calibrator database has also been incorporated into Observe (see also the entry for Observe in this Newsletter). Paper copies of the manual may be requested from Theresa McBride, Socorro.

G B. Taylor

VLA CONFIGURATION SCHEDULE

Configuration	Starting Date	Ending Date	Proposal Deadline
CnB	19 Jan 1996	05 Feb 1996	2 Oct 1995
C	09 Feb 1996	29 Apr 1996	2 Oct 1995
DnC	10 May 1996	10 Jun 1996	1 Feb 1996 5pm ET
D	14 Jun 1996	16 Sep 1996	1 Feb 1996 5pm ET
A	04 Oct 1996	16 Dec 1996	3 Jun 1996 5pm ET
BnA	27 Dec 1996	13 Jan 1997	1 Oct 1996 5pm ET
B	17 Jan 1997	21 Apr 1997	1 Oct 1996 5pm ET

The VLA is currently scheduling two large surveys. One will be done at nighttime in the DnC and D configurations (10^h-24^h and 14^h-04^h, respectively, for the 1996 D configurations) 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
1996	C	D	D,A	A
1997	B	C	D	D,A
1998	A	B	C	D
1999	D,A	A	B	C
2000	D	D,A	A	B

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 D configuration daytime will be about 07^h RA and the A configuration daytime will be about 14^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

OBSERVE

The most current version of observe is 3.2.14, dated 1994.04.17. For observations after December 31, 1995, please change the environment variable OBS_LEAPS to 30 in the observe shell script. We expect to release a new version of observe sometime during January 1996. This version will contain the new calibrator list, an alternative to keypad mapping, and assorted bug fixes.

W. K. Young

VLA UPGRADE PROJECT STATUS

Recent activity in the VLA Upgrade focused on project management and on continuation of development efforts begun earlier:

1. Organization. The areas of responsibility of the Project Scientist and the Project Manager have been defined. An Advisory Panel, consisting of six senior NRAO staff members, has been formed, and the duties of this panel have been defined. A number of working groups are being formed, each of which will have responsibility over system design in specific areas. Details of these groups' responsibilities will be published in the VLA Upgrade Memo Series.

2. New K-band feed system. The Central Development Lab continues design of the 18-26.5 GHz feed, polarizer, and low-noise cooled amplifiers. Current results indicate that a design with good polarization characteristics over this very wide bandwidth will be possible. Detailed design of the dewar awaits final definition of the size of the polarizer/amplifier package. Plans are being made to install two, or perhaps three, of these prototype systems on the VLA later in 1996 for detailed testing.

3. Feed ring design. The current concept for the Upgrade calls for eight frequency bands, with the feeds arranged around the feed ring. This is a very crowded arrangement, calling for careful placement of each feed. A three-dimensional model is being generated to ensure that all feed packages will indeed fit in this design.

4. R.F.I. Survey. There is great interest in expanding the low-frequency capability of the VLA for the Upgrade. However, it is also believed that the R.F.I. environment is likely to be very difficult for radio astronomy. A low-sensitivity R.F.I. survey, sufficient to identify very strong signals between 70 and 1800 MHz, is now underway and is expected to be complete by March of next year. The results of this survey should help considerably in specification of the observing bands below 1200 MHz. Work continues on a 50 MHz wide autocorrelator which will enable continuous monitoring of the current P-band and L-band R.F.I., independent of the observing band in use by the current observer.

5. A finite element analysis program, MSC/NASTRAN, has been purchased. This will enable sophisticated modelling of the response of the VLA antennas to various scenarios involving addition of low-frequency receivers, and modification of the quadrupod support legs.

6. Initial discussions with three long-distance telephone carriers have begun concerning the capacity and cost of high-bandwidth signal transmission via their optical fiber networks.

R. A. Perley

AOC COMPUTING STATUS

The VLA re-archiving project, which reformats and copies all VLA data onto Exabyte tape, has made reasonable progress. Currently, all data from 1976 through 1983 and from 1990 to the present have been re-archived. Work on the 1989 data is progressing reasonably well, but has met with some delay due to poor quality nine-track tapes. We are looking at alternative methods which allow faster handling of the problematic tapes we are encountering. The new VLA database which is being created automatically during the re-archiving is directly accessible via the NRAO home page.

Those who are planning a visit to Socorro in the future should check out the new "Socorro Visitor's Information Package" which can now be found on the Socorro, VLA, and VLBA pages of the NRAO home page. The first item concerns a list of "Public Workstations" at the AOC in Socorro and rules and guidelines by which they are assigned to visitors. Once you have made the decision to visit Socorro, you'll find the interactive "Visitor's Registration Form" helpful in making your reservation. It asks for all the information that is needed to book your stay in Socorro, including reserving a workstation. You can fill it out interactively and send it to the reservationist in Socorro. If you have forgotten some vital information, it will not let you submit the form until you have provided it. This new method simplifies and streamlines the reservation process enormously. When you submit the reservation form, we will have all the information necessary to make reservations for you. We'll no longer need to keep up an e-mail dialogue until everything is correct. Coming soon will be a third item in the package which will allow you to look at current and future workstation bookings at the AOC. This should help you when making plans to visit Socorro.

With the availability of 7 mm receivers at the VLA, pointing has become an important issue. The current state of referenced pointing is described in "Some Issues for Q-Band Observing," which is available on the WWW. Some improvements planned for the near future include: (a) Remove the restriction which limits pointing offset analysis to one subarray at a time. This will simplify the scheduling of pointing scans when multiple subarrays are used and allow the operations group more freedom in scheduling pointing runs. (b) Allow "second order" referenced pointing. This would remove residual inter-band pointing errors that remain after correcting for the pointing offset determined at longer wavelengths. It is not clear that the increased complexity of such a procedure is warranted except in the most demanding observations. We expect to have capabilities (a) and (b) available by April of 1996.

G. A. van Moorsel

PROBLEMS WITH ELECTRONIC SUBMISSION OF PROPOSALS FOR VLA/VLBA

Since the time the first observing proposals were received electronically in October, 1993, this mechanism has grown enormously in popularity. Today about 70 percent of all proposals arrive by e-mail. Of those, about 60 percent arrive within 24 hours of the deadline. While the majority go through without incident, some proposals encounter problems. The crush of activity just before the deadline means the NRAO staff are unable to solve all these problems or to even notify users that their proposal has been received. We are unable to answer inquiries on the status of proposals that arrive within one working day of the deadline.

We are able to notify users of problems with e-mail proposals and solve these problems only when the proposal is received at least one full working day in advance of the deadline. The same policy applies to acknowledging receipt of proposals. If you submit your proposal within one working day of the deadline, while we will make our best effort, we might not be able to either acknowledge receipt of your proposal or notify you of a problem with your proposal if one exists. If your proposal arrives during the last 24 "working" hours before a deadline and we do not succeed in printing it, such a proposal will be considered late and will miss that deadline.

We have encountered two "most common" errors with proposals sent electronically. Often, problems are due to the NRAO logo. These can be avoided by using the latest version of the cover and logo files (which can be retrieved through the WWW or anonymous ftp to "ftp.cv.nrao.edu," change directory to "proposal," read "instructions" file). Another solution is to comment out the line that requests the logo (near the top of the files covervla.tex or covervlbi.tex). The logo is not required! A second source of problems stems from the use of DIN-A4 paper by the user's "dvips" utility that creates the PostScript file. We can print most of those files, but the text is sometimes pegged to the bottom of the larger page and part of it is lost. Please get help from your local TeX expert in producing PostScript files on 8.5" x 11.0" paper.

Please send us only one e-mail per proposal, using "cat" or some equivalent utility to concatenate the "ps" files containing the covers, text, and figures to send us a single file. That file might not print in its entirety on your local printer, depending on the printer's "firmware" but should print on ours.

Proposals for use of the VLA, VLBA, and Global VLBI are due at the NRAO Director's office at 5:00 p.m. Eastern time on February 1, June 1, or October 1. If that day falls on a weekend or holiday, the deadline is the first following working day at the same time. The deadline is the same for proposals that arrive on paper or electronically. Please send your proposal using only one such method unless we request you to do otherwise; multiple copies of the same proposal lead to a substantial amount of confusion at a very busy time.

Our deadlines are designed to allow the shortest possible time between receipt of proposals and their scheduling, compatible with allowing the referees sufficient time for careful evaluation. Your cooperation in maintaining a proposal submission system that is both convenient and fair to all users will be appreciated. The best way we all can help is not to wait until the last day to submit our observing proposals.

J. M. Uson

NEW TRANSPORTATION OPTION

"Socorro Taxi" is the latest option available for transportation to/from the Albuquerque Airport. Travelers can make reservations directly with the Socorro Taxi shuttle service or can have the reservation made through the NRAO Reservationist. Listed below are the 24 hours a day accessible phone numbers and electronic address.

E-Mail address: jess@socorrotaxi.com
Phones: (800) 991-4276 or (505) 835-4276
Fax: (505) 835-2677

The rate per traveler is $43.67 for pickup at the airport and $42.40 per dropoff at the airport. The shuttle fees are paid directly to the Socorro Taxi service by the traveler. The service requests reservations be made 24 hours in advance. Upon arrival, travelers should call the 800 telephone number when ready to be picked up.

Socorro Taxi Schedule

Socorro to Albuquerque	Albuquerque to Socorro
0600	0900
1100	1400
1600	1900
2100	2300

Note: Please refer to the October 1995 NRAO Newsletter for other transportation options.

J. P. Lagoyda and M. T. Romero

IN GENERAL

THE MILLIMETER ARRAY

The Millimeter Array (MMA) Science and Technical Workshop in Tucson October 5-7 was an important milestone for the project as it allowed all of us, scientists and instrumentalists, a chance to examine critically the status of the technical design, via-á-vis our astronomical goals. The input to the meeting was the reports of the four Millimeter Array Development Consortium (MDC) working groups which present the current technical goals and specifications for the MMA. There are four such MDC reports: (1) Systems; (2) Antennas; (3) Phase Calibration; and (4) Receivers. Copies of these reports are on the WWW and can be reached by following the MMA path from the NRAO Home Page to the MMA section on the October Workshop.

The MMA Workshop itself was also structured around Working Groups. There were five science working groups as follows, listed with the group chair: Cosmology and Extragalactic Astronomy (J. Carlstrom); Star Formation and Stellar Evolution (J. Bieging); Astrochemistry (E. van Dishoeck); Solar System (P. Schloerb); and The Sun and Stars (T. Bastian). Each of these workshop science groups produced a report of their discussion and all the reports are also accessible on the WWW from the same pathway to the MMA Workshop section as described above. I certainly encourage all of those interested in MMA science to obtain a copy of the meeting Working Group reports. Let me know if you have trouble getting to the electronic version and I will make other arrangements to get the material to you.

Immediately following the MMA Science and Technical Workshop the Millimeter Array Advisory Committee (MAC) had its annual meeting to review the workshop and to make recommendations to the NRAO Director. The MAC is chaired by Neal Evans and includes as its membership: F. Adams, T. Bania, J. Bieging, J. Carlstrom, E. Churchwell, N. Erickson, P. Goldsmith, R. Hills, J. Knapp, C. Masson, P. Schloerb, P. Solomon, J. Turner, R. Wilson, G. Wynn-Williams, and E. van Dishoeck. The MAC report of the MMA Workshop, including a workshop summary and the 1995 Recommendations of the MAC, is also available on the WWW in the MMA section of the NRAO Home Page; see also Neal Evans' article below.

We are grateful to all of those who participated in the MMA Workshop, to those in Tucson who handled the local meeting organization (special thanks to Jennifer Neighbours and Dale Webb), and to the Allstate Insurance Company whose meeting next door to the MMA meeting room one evening added an unforgettable, albeit unintended, element of unbridled enthusiasm for millimeter-wave astronomy that was a joy to hear from our citizen-supporters.

R. L. Brown

REPORT OF THE MILLIMETER ARRAY SCIENCE WORKSHOP

1. Summary of the MMA Science Workshop

On October 5-7, 1995, nearly 100 scientists and engineers gathered in Tucson for a workshop on the topic of the Millimeter Array (MMA). The twin objectives of the meeting were to update the scientific goals for the MMA and to compare those goals to the strawman design that had been developed by the technical working groups. To achieve the first goal, five scientific working groups and a technical group held separate meetings. To achieve the second goal, joint meetings were held. The scientific working groups summarized their conclusions in written reports. Each report contains recommendations on technical requirements pertinent to the goals of that group. Many of the technical requirements are a result of a very productive give-and-take between the scientific and technical working groups, which characterized the spirit of the workshop.

The Millimeter Array Advisory Committee (MAC) met at the conclusion of the meeting and agreed on a set of recommendations for the future development of the MMA. These recommendations were subsequently refined, based on the working group reports, and are presented below. The most salient recommendation of the MAC is that development of the MMA should proceed as soon as possible. The scientific case for the MMA, already strong when the proposal was written, has become much stronger. The pioneering work of the existing arrays has opened new areas for research that can only be properly developed with the MMA. The excellent atmospheric properties of the sites now under consideration and the advances in technology since the MMA proposal also led the MAC to recommend initial operation with a submillimeter band and outrigger stations to allow resolution significantly better than 0.1 arcseconds. The MAC also identified capabilities in the original proposal which are now of less importance.

The scientific goals demonstrate the broad scope of MMA science. From the largest structures in the Universe to the smallest, near-Earth objects, the MMA will revolutionize our understanding. The origin and evolution of galaxies, stars, and planetary systems will be studied by the MMA. The scientific and technological foundations for the MMA are sound. We believe it is time to move forward with this revolutionary scientific instrument.

2. Recommendations of the MAC

1. We enthusiastically endorse the basic plan of the MMA, as outlined in the original proposal, further developed by the MDC technical working groups, and updated as described below. We believe it is crucial to proceed with development of the MMA as soon as possible.

2. Both sites under current consideration (Mauna Kea and Chile) look extremely attractive, especially from the point of view that submillimeter observations are possible. The site in Chile has some advantages (even better atmospheric transmission, a larger area for the long baselines, and access to the southern sky, including the center of our Galaxy and the Magellanic Clouds). Since we have only half a year of testing in Chile, we recommend continued testing and consideration of both sites. We also recommend that medical advice on the effects of working at the altitude of the Chile site be solicited.

3. The excellent atmospheric properties of both sites, along with the scientific considerations of the science working groups, point to the need for the array to include a submillimeter capability at the outset. We recommend that the dewar be designed with windows for the three submillimeter bands and that the INITIAL receiver complement include a receiver for the 650 GHz window. This receiver need not include dual polarization. We believe that the submillimeter capability should be considered in the other specifications, but our current understanding is that the basic design suggested in the last report of the technical working group, including the CFRP backup structure, is adequate for submillimeter work. We are not asking for further enhancement in the specifications. Any further effects on the specifications should be reported to the MAC for evaluation. Estimates for the cost of submillimeter receivers should be developed by the receivers group in the near future.

4. The new sensitivity estimates open up new possibilities for even higher spatial resolution. We recommend that the array be designed for INITIAL operation with at least two outrigger stations at a 5 km radius. We recommend studies of the optimum number and placement of outrigger stations and the limitations that optical fiber non-linearities might place on very long baselines. The possibility of extension to even longer baselines (up to 30 km was suggested) should be considered in site evaluations, cost considerations, and uv coverage analysis. Baselines longer than 10 km would be designed for resolution of very compact objects, such as stellar photospheres and possible gas-giant protoplanets. The imaging requirements should be viewed in the light of those goals.

5. The correlator should have eight, rather than four, independent spectral channels, but not more lags. In general, flexibility in the correlator should be enhanced, rather than the number of channels. We recommend including the option of very high resolution (10 Hz) for planetary radar as an option that does not drive the design. In particular, F-X designs should not be ruled out by this option if they prove to be superior in other ways .

6. Items 3-5 reflect enhancements to the basic design and are roughly in order of importance as perceived by the MAC, interpreting the reports of the working groups at the meeting. In particular, we noted that the correlator enhancement should not be done at the cost of items 3 and 4. We also identified some negative enhancements, items which could be eliminated. The MAC voted strongly in favor of eliminating all these if necessary for cost or other reasons.

- nutating subreflectors (pending up-coming tests of alternatives);
- the 36-50 GHz band (but keep the 26-36 GHz band);
- capability for simultaneous, dual-band observing (with a possible exception for calibration of the submillimeter bands);
- special adaptations for solar observing, which drive either the design or cost.

7. We recommend a reconsideration of the optimization between number and size of dishes. The re-optimization should include the changes listed in items 3-6 above. The recommendations of the working groups were not uniform on the effect of the science goals in this re-optimization. The MAC was evenly split on whether the science goals favored more or larger dishes.

8. We recommend activation of the working groups on Software and Data Management, which are rumored to exist.

9. We recommend that a prototype antenna be built for testing purposes. We do not recommend a separate test array. Instead we recommend that NRAO staff spend time at the existing arrays to gain experience and test ideas cooperatively with the other MDC members. If tests with the MMA antennas are necessary, NRAO should consider doing these with the university arrays.

10. We recommend that NRAO hire, as soon as possible, one or more scientific staff members who have experience with the existing millimeter arrays.

11. The efforts of the MDC working groups have improved the design significantly, and we recommend continuation of this collaboration. Similar collaboration with existing submillimeter groups should be considered for the optimum development of submillimeter capability.

12. We recommend that each Technical Working Group include a member of the MAC.

Neal Evans (MAC Chairman)

AIPS++ PROJECT

In single dish processing, the Charlottesville-based group (Bob Garwood, Darrel Schiebel, and Paul Shannon) continues to work closely with the GBT on providing AIPS++ software for single dish processing. The most important goal is to allow use of AIPS++ single dish data analysis processing by a first user on the 140 Foot in June 1996. This is a key milestone in the overall goal of providing a complete SD analysis package for the commissioning of the GBT, now expected in the summer of 1997. In addition, the ATNF has decided to use AIPS++ to support an HI survey using a 13-feed multi-beam system on the Parkes telescope, scheduled for August 1996. To support this work, David Barnes will travel to Charlottesville for eight weeks early in 1996 to work with the SD group.

Darrell Schiebel has developed an extension to Glish, called Glishtk, that allows development of a Tk-widget based GUI from inside Glish. This was developed for the GBT work, but is expected to be used in a wide range of different applications. Paul Shannon has developed a number of tools based upon Glishtk; the major being a system for providing help for users of Glish and a tool for overseeing and controlling the filling of GBT monitor and control data into AIPS++.

Wim Brouw has made excellent progress on designing and implementing a cornerstone of the AIPS++ Project, the Measures Classes. Working from an original design by Mark Calabretta, he expects to have all of the system, apart from high-precision VLBI support, available by April 1996.

In synthesis processing, Mark Wieringa and Tim Cornwell have produced a design for synthesis calibration and imaging based upon the Measurement Equation for a Generic Interferometer developed by Hamaker, Bregman, Sault, and others. The short term goal is to produce a self-calibrated and cleaned image from VLA data, incorporating corrections for polarization leakage, by the end of the year. Development will then proceed on various fronts. One important goal will be to allow support of the commissioning of the new WSRT on-line control system, TMS, expected to commence in August 1996.

Tom Osterloo has joined the AIPS++ Project at ATNF to work on visualization and image analysis software in collaboration with the NCSA group headed by Dick Crutcher. Tom brings a wide range of expertise and experience in visualization, having worked with Richard Gooch for a couple of years inside the Karma system.

The Table system continues to evolve and grow. Ger van Diepen of NFRA has recently worked on a Tiled Storage Manager that allows efficient access to multi-dimensional arrays in different directions. This will be vital in many different application areas.

The Project was well-represented at ADASS this year. Presentations were made by Brian Glendenning (OO Design in AIPS++), Dick Crutcher (AIPSView), and Bob Garwood (the GBT work), and, in addition, posters were presented by Darrell Schiebel (Glish) and Paul Shannon (GUI design).

In addition to these major areas, work continues on many different topics, e.g., a revised Image (Tim Roberts), design and implementation of the Tasking structure (Brian Glendenning), vector graphics inside AIPSView (Harold Ravlin), programmer documentation (Young), and many, many system level improvements (Mark Calabretta).

T. J. Cornwell

IAU COLLOQUIUM 164: RADIO EMISSION FROM GALACTIC AND EXTRAGALACTIC COMPACT SOURCES

This conference will be held in Socorro, 21-26 April 1997, and is sponsored by IAU commissions 28 (Galaxies) and 40 (Radio Astronomy), URSI (commission J), NRAO/AUI, and New Mexico Institute of Mining and Technology.

This meeting will bring together researchers interested in the astronomical use of VLBI, and it will provide a forum not only for the discussion of results but also for the formation of new technical and scientific ideas that will shape future expansion projects for the VLBA. Roughly, half of the meeting will be devoted to the discussion of recent astronomical results, and the other half will focus on technological developments.

The Scientific Organizing Committee is composed of: A. Zensus (chair, azensus@nrao.edu), M. Inoue, D. Jauncey, J. Moran, G. Nicolson, L. Padrielli, R. Schilizzi, P. Wilkinson, A. Witzel, and Shenying Wu. The Local Organizing Committee is chaired by Joan Wrobel (jwrobel@nrao.edu).

Details will be made available under the NRAO home page on the WWW (http://www.nrao.edu/).

J. A. Zensus

USERS COMMITTEE MEETING

The 1996 meeting of the NRAO Users Committee will be held June 17 and 18 in Charlottesville. This date for the meeting was chosen sufficiently late that it follows the AAS meeting and the end of the spring classes. On the other hand, we hope it is not so late that people are away for their summer activities. In any case, the meeting will occupy a day and a half, ending at mid-day on Tuesday, June 18.

The chair of the Users Committee for 1996 is Mary Barsony. If there are issues that you would like to see discussed by the Users Committee, I encourage you to contact Mary directly. A meeting agenda will be distributed to the Committee members later in the spring, and it will also be made available on the WWW.

R. L. Brown

1996 SUMMER STUDENT DEADLINE 19 JANUARY

NRAO is accepting 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, further information, and a summary of last year's program are available on the WWW (URL: http://www.cv.nrao.edu/~awootten/summer-students.html). Forms have been sent to Department Heads; they may also be obtained by writing to:

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

H. A. Wootten

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