NRAO NEWSLETTER

1989 April 1 No. 39

GREEN BANK

NEW GREEN BANK TELESCOPE

The loss of the 300-ft telescope in Green Bank and the subsequent initiatives undertaken by Senators Byrd and Rockefeller of West Virginia to provide for the construction of a state-of-the art replacement telescope in Green Bank have required NRAO to put increased emphasis on all aspects of its responsibilities in the field of single-dish radio astronomy.

Of primary importance is the need to ensure that the entire astronomical community is brought up-to-date on the scientific rationale for a large aperture, fully steerable, high performance telescope. To this end, the proceedings* of the workshop convened to address this subject in Green Bank on December 2-3, 1988 have been mailed to all recipients of the NRAO Newsletter and have been made available to the NSF Advisory Committee for Astronomical Sciences and other organizations. This report summarizes opportunities in single-dish astronomy that have been recognized in earlier reports dating as far back as the NAS/NRC Greenstein Report nearly twenty years ago. It is our judgement that the depth and scope of the scientific case that has been developed is compelling.

Building upon earlier design experiences and upon modern engineering developments, an Observatory team of engineers and scientists have been investigating the trade-offs in cost and performance benefits for a number of advanced antenna systems. Among the many options that are being addressed are: conventional versus unblocked apertures; collecting area versus frequency cutoff; passive versus actively controlled surface adjustment. The results so far are very encouraging. It is clear that an extremely versatile and powerful 100-m class telescope can be achieved at a total cost of about $75 million. NRAO continues to emphasize the importance of ensuring that funding for the new telescope be fully developed as an addition to the on-going NSF astronomy program.

A detailed plan defining the scientific justification, the technical concepts and construction schedule is in preparation.

P. A. VANDEN BOUT

* "A Radio Telescope for the Twenty-First Century - Scientific Considerations for the Design of a Replacement for the 300-foot Telescope," proceedings of a workshop held at the National Radio Astronomy Observatory, Green Bank, WV, December 2-3, 1988, R. L. Brown and F. R. Schwab, editors.

CAUSE OF TELESCOPE COLLAPSE IDENTIFIED

The Technical Assessment Panel jointly appointed by NSF and AUI has submitted its report on the cause of the collapse of the 300-foot telescope. They conclude that the collapse was the result of the sudden failure of a key structural element--a large gusset plate in the box girder assembly that formed the main support for the antenna. Laboratory analysis of the broken plate established the history of its failure: an initial crack that had progressed slowly, perhaps over the lifetime of the telescope, followed by a sudden rupturing of the plate.

A finite-element, space-frame stress analysis of the antenna structure, not possible when the antenna was designed, revealed a number of structural members with stresses in excess of modern design criteria. This is the likely cause of the initial progressive cracking of the gusset plate. This initial crack could not have been discovered in the regular maintenance inspections of the telescope because it was hidden behind other structural members and many layers of paint.

The specific trigger that precipitated the sudden rupturing of the plate on November 15, 1988, if there was one, remains unidentified. Among many possibilities are increased stress on the plate due to the failure of some other structural member or a bearing seizure. Inspection of the west tower bearings revealed internal damage, but the bearing shaft could be turned freely. Inspection of the east bearing must wait until a professional crew begins removal of the wreckage.

Members of the panel are Edward Cohen, managing partner with Ammann & Whitney, a structural engineering consulting firm; Robert M. Matyas, a private construction and management consultant and vice president emeritus of Cornell University; and George F. Mechlin, recently retired vice president for research and development of the Westinghouse Electric Corporation. Panel observer members included: Kenneth J. Johnston, Naval Research Laboratory; Ludwig Oster, National Science Foundation; and Ron Williams, U.S. House of Representatives Committee on Science, Space & Technology.

P. A. VANDEN BOUT

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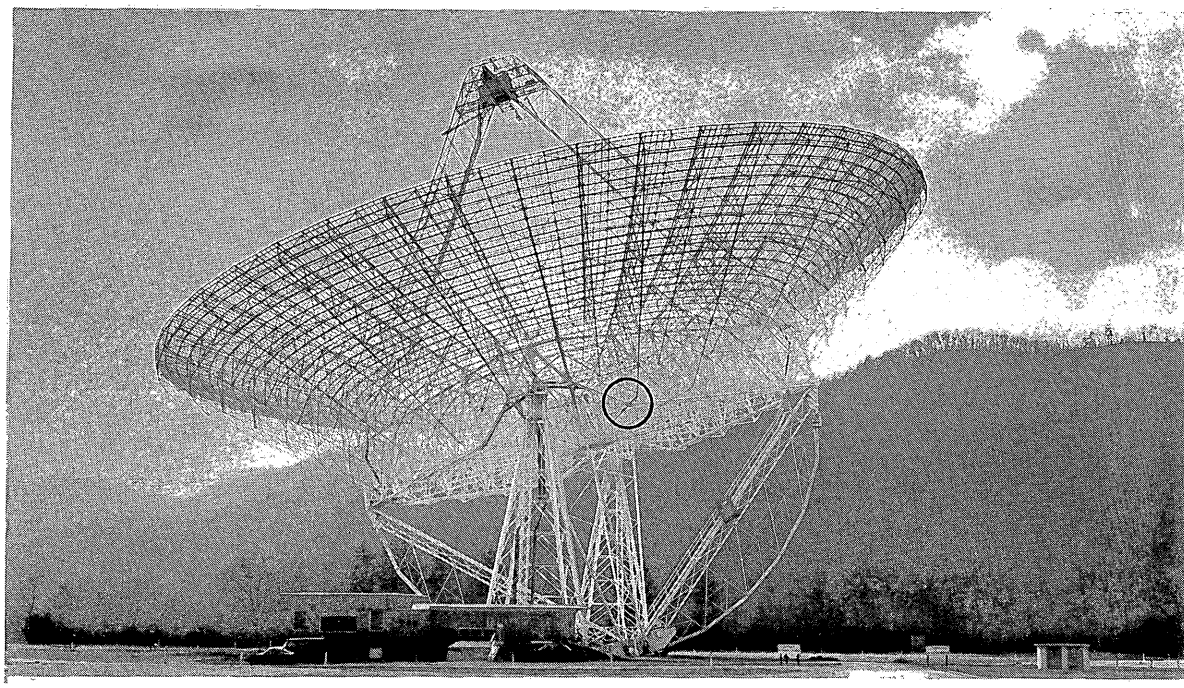


Fig. 1. The 300-ft telescope. The circle identifies the location of the failed gusset plate concluded to be responsible for the telescope's collapse.

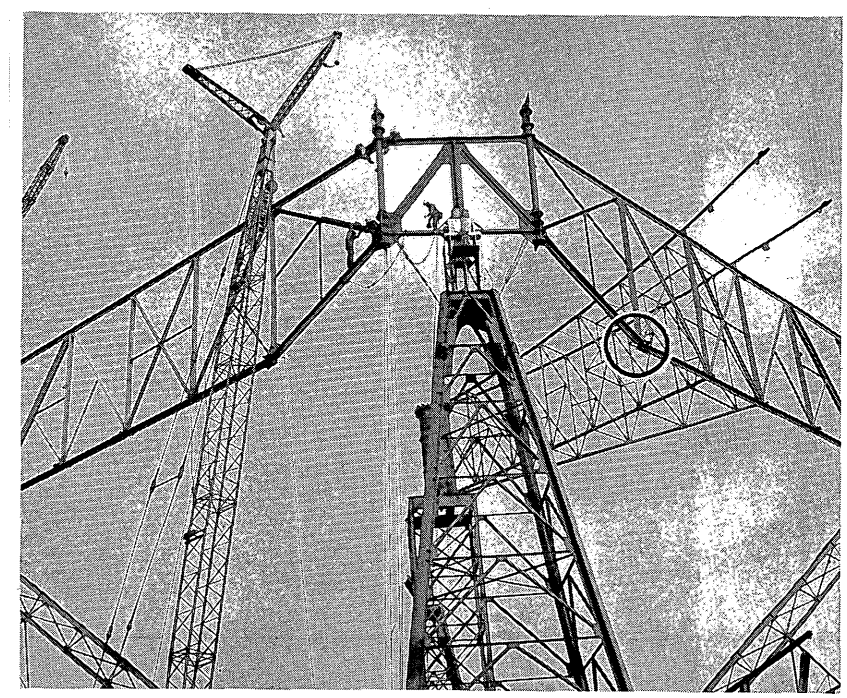


Fig. 2. The assembly of the 300-ft telescope diamond truss structure, photographed October 5, 1961. Circle identifies the location of the gusset plate that failed 27 years later, after approximately 10^6 stress cycles.

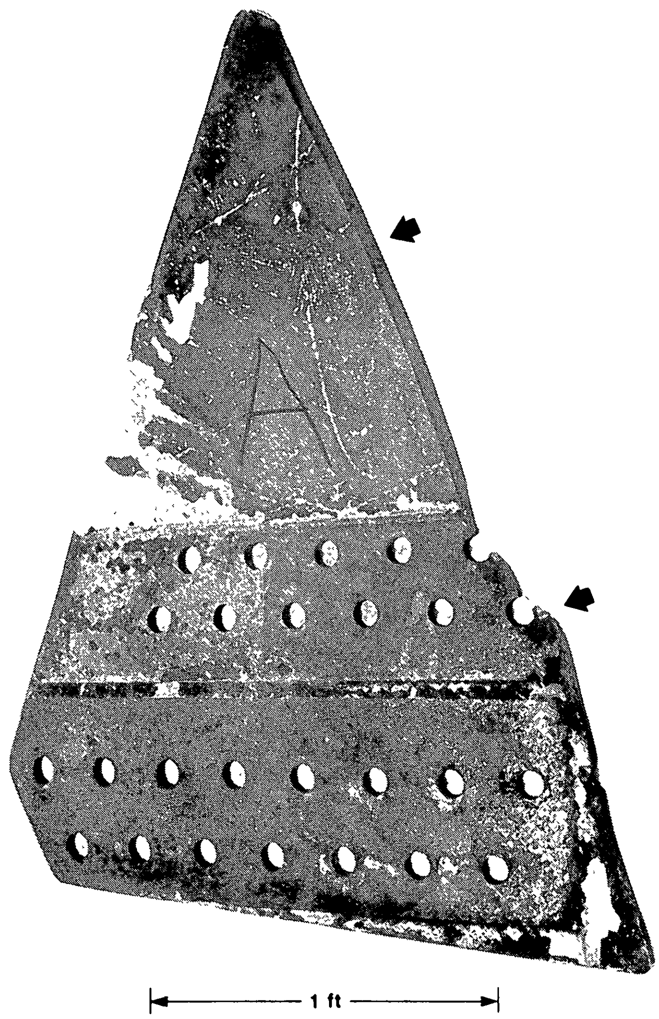


Fig. 3. The failed gusset plate, one-half inch thick, as recovered from the wreckage and subjected to metallurgical examination. The plate fracture was 37 inches long (arrows) and intersected the two holes. The initial fatigue crack propagated downward from the lower arrow. Portions of white paint are seen at the left.

7-FEED/6-CM RECEIVER UPGRADE

During the collapse of the 300-ft telescope, the 7-feed/6-cm receiver received minor damage requiring repairs to copper brackets supporting the cooled FET amplifiers. Because of the work involved in repairing the support brackets, i.e., removing the dewar from the receiver and disassembly, it was felt that this would be a good opportunity to improve the receiver noise temperature by replacing the original FET amplifiers (built in 1985) with new HEMT amplifiers.

Construction of all HEMT amplifiers is now complete and they are presently undergoing testing. After the amplifiers are tested, they will be installed in the vacuum dewar and complete testing of the 7-feed/6-cm receiver will commence. If all goes well, it is expected that the receiver will be ready for use by 21 April, 1989.

Measurements at the 140-ft telescope made in June 1987 on Channels 7A and 7B (those channels connected to the center feed and using the original FET amplifiers) yielded system noise temperatures of 51 K and 52 K, respectively. Since the new HEMT amplifiers have measured noise temperatures of 7 K, or an improvement of 13 K over the original 20 K FET amplifiers, we can expect the new system noise temperature to be less than 40 K. They will also perform better over a wide bandwidth, 4.2 to 5.2 GHz.

G. H. BEHRENS

UPGRADES FOR THE 140-FT CASSEGRAIN RECEIVER

New receivers for the 140-ft Cassegrain system are currently under development. Cooled HEMT amplifiers are being designed by the Central Development Lab to cover the 25-35 GHz frequency range (Ka band) and to replace the upconverter series over 5-18 GHz. The 18-25 GHz (Ku band) masers will not be altered. Two independent receivers are being built to receive orthogonal polarizations. We expect more uniform gain response and improved noise temperature vs. frequency using transistor amplifiers as well as better stability and reliability. Noise performance vs. frequency was shown in the July 1, 1988 Newsletter.

A mixer-type Cassegrain test receiver at 32.7 GHz is being used to determine if aperture efficiency measurements at K band can be reliably extrapolated upwards in frequency. First tests were favorable in that the beam did not show strong sidelobes or excessive broadening. Pointing offsets and axial focus are essentially unchanged from K band. Intentionally underdamping the nutating subreflector transient response did not seem to affect source temperature; we were concerned that a possible "ringing" of the subreflector surface would degrade performance at Ka band. The aperture efficiency vs. frequency relationship follows a straight line on a log-log plot as far as 32 GHz. More comprehensive tests are planned shortly.

Our plan is to build the local oscillator and IF system for the new receivers concurrent with Ka HEMT development. Ka observations would then be possible in early 1990 by cooling the Ka amplifier (temporarily) in the maser dewar. Completion of the first full band (5-35 GHz) HEMT receiver is set for the end of 1990, with both receivers ready in late 1991.

C. J. BROCKWAY

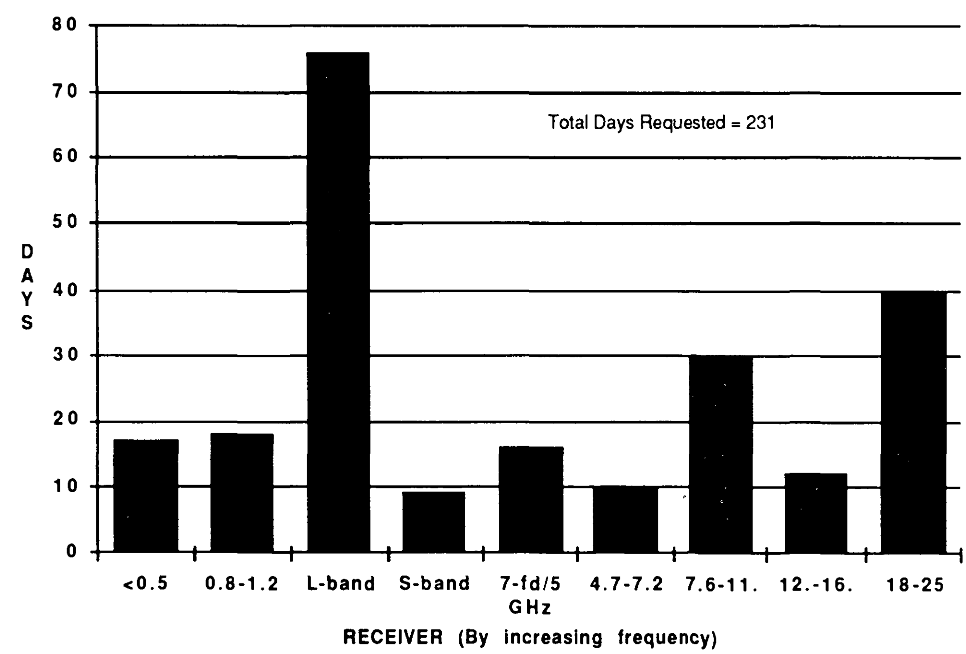
PROPOSAL QUEUE FOR 140-FT TELESCOPE

As of March 1, 1989, a total of 231 days telescope time has been requested for the 140-ft telescope, exclusive of VLBI observations (approximately 80 days annually). The distribution of requests for different frequency bands is shown in the accompanying figure. This distribution is, of course, dependent on when the information is summarized. For example, the K-band frequencies (18-25 GHz) have nearly all been scheduled by March 1 to take advantage of winter observing conditions.

All unscheduled 300-ft telescope proposals had earlier been returned to the Principal Investigators with the burden placed upon them of deciding whether or not to resubmit. Three P.I.'s quickly did apply for 140-ft telescope time, but other 300-ft telescope projects apparently were not suitable for the 140-ft telescope. It is obvious that the 140-ft telescope cannot serve as an adequate substitute for the 300-ft telescope.

The 140-ft telescope will be used more for pulsar observations and for neutral hydrogen redshift determinations than it would have in the absence of the 300-ft telescope's collapse.

G. A. SEIELSTAD



SPECTRAL PROCESSOR

The spectral processor is now intended to go to the 140-ft telescope. Initially it will be used for pulsar measurements, but, as the demand warrants, it will be available for spectral line observations. For spectral line observations the main advantages of the spectral processor over the Model IV autocorrelator will be higher tolerance to interference and twice as many IF inputs (8 instead of 4). A few comparative specifications are given at the end of this note.

We expect to run some pulsar tests at the 140-ft in April, possibly on signals from antenna 85-3. The first regular observations will be pulsar timing sometime this summer. Since communications with the Modcomp telescope control computer are limited, the spectral processor will be run in stand-alone operation with parallel observing schedules running in the telescope control and spectral processor computers. The spectral processor will record its data on its own tape drive. Stand-alone operation seems adequate for pulsar work, and we will let demand drive the necessity to integrate the spectral processor into the telescope control and data acquisition environment. This will require a significant number of software changes in several computers.

The hardware for half of the 2048 channels has been pretty thoroughly tested as a system. Cards for the second half have been built and tested and will be integrated into the system after the April test run. Communications software between the MassComp and the hardware controller has passed its initial try. Setup and data formats are defined. Maser-based timing transfer from the clock to the MassComp and hardware controller is now being checked out. For the April tests we are concentrating on software necessary for pulsar timing using the time/frequency matrix data integration mode, and we expect to spend at least the rest of 1989 filling in software for the other modes and enhancing the data monitor displays and setup user interface. For a while each observing run will be treated as a special case, so make your requirements known well in advance.

	Model IV Autocorrelator	Spectral Processor
IF Inputs x Bandwidth	4 x 80 MHz 4 x 40 4 x 20 4 x 10 etc.	2 x 40 MHz 4 x 20 8 x 10 8 x 5 etc.
Total Number of Channels	512 @ 80 MHz 1024 ≤ 40 MHz	2 x 1024
Approximate Relative Sensitivity	0.81	~ 0.7 with 2048 chan > 0.9 with effectively 1024 chan
Time Resolution	10 sec	25 μs @ 4 x 512 12.5 μs @ 4 x 256 Depends on Bandwidth
Approximate Sidelobes on Narrowband Interference	-20 dB	-40 dB Depends on Taper Fn
Integration Modes	Total Power Switched Power Pulsar Synchronous Spectral	Total Power Switched Power Pulsar Synchronous Time or Spectral Time/Freq Matrix Dedispersed Time

J. R. FISHER

UPGRADES FOR THE GREEN BANK INTERFEROMETER

About a year ago the U.S. Naval Observatory asked for a major upgrade to the three 26-m (85-ft) antennas at Green Bank. One of the antennas (85-3) is to be devoted to geodetic VLBI, as a part of a network dedicated to near-real-time measurements of UT1, polar motion, and nutation. In addition to time-keeping and navigation, these data are used to study short-term oscillations and irregularities in the earth's rotation and their relation to weather patterns and ocean currents.

Since the VLBI operations would use, on the average, a few hours per day, a pulsar monitoring program was designed to use the remaining time on antenna 85-3 and to run automatically with very little supervision. This program, directed by J. Taylor and D. Stinebring of Princeton University, is designed to watch speed-ups, "glitches," and other irregularities that provide clues to pulsar structure.

The remaining two 26-m antennas now function as a single-baseline interferometer devoted to monitoring variability of compact, extragalactic sources for K. Johnston and R. Fiedler of NRL. As well as keeping tabs on intrinsic variations, this survey discovered several unusual scattering events probably due to a population of small, dense, ionized, elongated structures in the interstellar medium, a previously unknown component of the galaxy.

The major part of this upgrade project is the building of four dual-frequency (S and X band) feeds with cooled receivers (system temperatures of 20-30 K), capable of observing simultaneously both frequencies and both circular polarizations. Three of these receivers will be used on the 26-m antennas at Green Bank. The fourth will be used on the 14-m (46-ft) antenna, to be moved to a remote site (probably either in Florida or Hawaii) and become part of the USNO geodetic VLBI array. (The details of the 14-m antenna move have not yet been decided.)

Other important components of this upgrade include a new control computer for antenna 85-3, because it must be operated independently of the other two; software changes to the old interferometer control computer to accommodate the new receiver and LO design; and the use of optical fibers for transmission of LO and IF signals as well as control and monitor information to and from the antennas. The LO and IF signals for the VLBI observations are carried by optical fibers between antenna 85-3 and the Mark III VLBI terminal at the 140-ft building, a distance of about 2.5 km, with a loss of only about 10 dB.

To control antenna 85-3, an AST-type PC was programmed in PASCAL by J. Cercone of West Virginia Tech. This control program has proven to be reliable and easy to use. Making additions and modifications to the program is relatively painless.

The first of the new S/X band receivers was completed in October 1988, and after testing and adjustments, was installed on antenna 85-3 in mid-November. The necessary fiber splicing and completion of equipment to extract the two IF's, clock and LO signals from the fibers was done by late January. In early January, pointing calibration observations were done to determine the pointing correction model for 85-3. Finally, on the 25th of January, the first successful VLBI observations were carried out.

The series of USNO-sponsored VLBI observations in which Green Bank is participating includes antennas located near Fairbanks, Alaska; at Richmond, Florida; on Kauai, Hawaii; and at Maryland Point. Occasionally, the antenna at Medicina, Italy also participates. At the present, an 8-hour observation is done about once a week, and a 24-hour run is done once a month. After a few months, USNO intends to add a short (3-hour) daily run, to achieve near-real-time monitoring of UT1 and polar motion.

The pulsar monitoring project began a shakedown in late January 1989 using a 610 MHz feed mounted on antenna 85-3. Twenty 1 MHz wide channels are recorded simultaneously. A 327 MHz system will be added this summer. The pulsar data acquisition system is controlled by a PC which records data only when it receives a message from the antenna control computer indicating that a pulsar is being observed. The pulsar PC also has an Ethernet connection to a Masscomp computer in the interferometer building so that its data files can accumulate on the Masscomp's large disk for a week (about 40 MB of data) before being written to tape and sent to Princeton for analysis. In the future, the data reduction will be done on the Masscomp and the results can be transmitted by a phone line or by electronic mail.

The NRL variable source monitoring and survey for small scattering clouds will benefit from the increased sensitivity of the new S/X band receivers. Because the RF band center frequencies are different than in the old receivers, and because the new LO system will not include lobe rotators, we require some modifications to the old interferometer control software, which are currently being carried out by G. Conant. These two receivers and software changes are expected to be completed by early summer.

F. D. GHIGO

SINGLE-DISH DATA ANALYSIS--GREEN BANK CHANGES

As noted below, NRAO has finally decided to put a significant effort into revising its single-dish analysis software. Here I describe the changes observers can anticipate seeing in Green Bank over the next few months. These changes have been made possible by the recent computing purchases and are long overdue.

The first major change is that analysis will no longer be done on the Modcomp computers but instead will be done on SUN workstations. Presently, we have a SUN at the 140-ft which runs a version of the LINE and CONDAR analysis programs similar but superior to the program which now runs on the Modcomps. The SUN is tied into, collects, and stores the data from the control computer. After we complete some trivial computing details with the SUN, we will be removing the Modcomp analysis computer from the control room.

After the removal of the Modcomp, we will work on getting the Tucson version of these programs working on the SUN. Until that is completed sometime this spring, observes can take advantage of many of the features that a modern machine like the SUN provides but which the Modcomps were incapable of.

For example, much larger data files can be stored on the disk. That is, the Modcomp's limit of 1500 scans has been expanded to about 30,000 scans. The Modcomps have very limited disk space for storing reduced data, but now the SUN has increased these storage areas by a minimum factor of 20. Many user-friendly features have been and will be added to the analysis programs. An observer can now easily mix old data with data presently being observed. Each observer has his own areas on disk for storing procedures and scans; that is, each observing team can process their own data in their own way but cannot look at or accidentally destroy the data or procedures of another team of observers.

The Local-Area-Network provides Green Bank with many capabilities which did not exist in the past. As an example of what the Network provides, an observer can now sit at any SUN workstation on site (we have one at the 140-ft and two in the Jansky Lab) and process their data as it is coming in at the telescope. In fact, if observers don't need to use the graphics capability of the analysis programs, they can use any terminal on site to reduce data. More than one person can reduce data at the same time. If a certain analysis problem has certain requirements, then the observer can use the computer best suited to the problem. In experimenting with the Network, we have been successful in reducing data while remotely logged onto the Green Bank system from Charlottesville and elsewhere. We may eventually open this capability to the general user.

In addition to upgrading the analysis programs, our future plans include placing three Mac II's, one of which may be located in the residence hall, on the Network and to use them as additional analysis computers. When completed, the Spectral Processor will use the Network in order to provide data to the analysis programs. We have only recently installed ANALYZ, the analysis package used at Arecibo, onto the Network since it appears to be a possible replacement program for our current analysis programs. However, some work needs to be done to the program so that it can accept data from the 140-ft telescope.

R. J. MADDALENA

SINGLE DISH DATA ANALYSIS--OBSERVATORY WIDE CHANGES

The reduction of data taken with NRAO telescopes has been occasionally frustrating for some observers. There are many reasons why observers have had bad experiences. For example, Tucson, Green Bank, and Charlottesville each have similar but different analysis programs. The differences are so significant that the analysis commands which work at one site do not work at any other. The 15-year old Modcomp computers at Green Bank cannot support many of the advanced and user-friendly features found on the computers (mostly VAXes) at the other sites. When a bug is fixed at one site, the other sites would typically not be informed about it. Exported data tapes are written in different formats at each site. Documentation concerning changes and updates to the analysis programs do not exist in many cases.

NRAO has committed itself to correcting many of these faults. Within the last six months and continuing over the next few months, we are completely overhauling the single-dish analysis programs. These changes are being installed piece by piece at the various sites so users can benefit from the advances as we make them, and they will not have to wait for the completion of the project.

The project consists of the following stages:

1. The installation of the analysis programs originally found on the Green Bank Modcomps onto a SUN workstation. This includes adding many modern programming features not possible with the Modcomps.

2. Replacing the Green Bank Modcomps with SUN's so as to take advantage of the full power of the Green Bank Local-Area-Network.

3. Installing the more modern Tucson programs onto SUN's. This includes removing or isolating all site and machine-dependent features from the code. Also, the necessary or superior parts of the Green Bank program will be inserted into the revised Tucson program.

4. Purchasing SUN workstations for Tucson and Charlottesville so that analysis at these sites can also benefit from many of the windowing features found on the SUN. Installing the above programs on these machines, once they are purchased.

5. Re-installing this version of the program back onto the Tucson and Charlottesville VAX computers. (We speculate that eventually all single-dish analysis within NRAO may be done on SUN's. However, the VAXes may be around for a while.)

6. Instituting a method whereby changes at one site are automatically propagated to the other sites. We will create certain programming guidelines, similar to those used by the AIPS group, to insure that the analysis programs will remain portable between the sites. We will also make sure that users are provided with up-to-date documentation and code.

7. Creating a method whereby observers can obtain either a VAX or SUN workstation version of the analysis programs for their use at their home institution. A revision and distribution method, similar to or the same as the AIPS method, will eventually be used.

8. Once the programs become stable and less manpower needs to be devoted, we will start looking into either finding or writing the next generation of analysis programs.

Stage 1 has already been completed and Stage 2 will be completed within a week or two of my writing this. Stage 3 is almost half completed. For Stage 4, Tucson already owns a SUN and Charlottesville has or soon will order SUN's. All sites agree on how Stages 5 and 6 are to be accomplished, and both stages should be well on their way to completion by the summer. Stages 7 and 8 are presently being discussed by NRAO programmers and scientists.

R. J. MADDALENA

VLBA

SELECTED ITEMS

Operation - The second of the VLBA antenna sites, Kitt Peak, AZ, has received its "final" outfitting. "First light" was observed on February 21. First fringes, at 6 cm, were obtained on 9 March with Pie Town and the VLA, utilizing the antenna's Mk II terminal. It is hoped to have Kitt Peak available to the Network in the June run. During recent months the Pie Town station has been largely utilized for system refinement, station computer software improvement, installation of outfitting upgrades, and an on-going program of antenna performance data collection. A Mk III Crustal Dynamics run, at 2.3 and 8.4 GHz simultaneously, was scheduled for March 27 at Pie Town.

Computers - In the fall of 1988, the real time operating system "Vx Works" was chosen for the VLBA Correlator Motorola 680X0 control computers, with SUN workstations under UNIX providing development emulations, cross compiling, software maintenance support, and eventual central control of correlator operations. A recent, related decision was made to convert the VLBA Monitor and Control system to operate in the same environment. This means that the VLBA array control computer will now be a SUN with workstations, already ordered for near term delivery.

Expected in addition to performance enhancement is shorter software development time, more compatibility between correlator and array control systems at the AOC, and avoiding the long-term inefficiency of maintaining two different VLBA operating systems. The programming efficiencies, especially in implementing processor to processor communications, and good compiler and other support experienced by other observatories with this system allows schedules for system integration of array and station computer software to remain unchanged.

Correlator - A milestone was reached in development of the FX chip, marking culmination of the first of three contract phases. NRAO's "pre-layout" design simulation and test vectors were accepted by the vendors, Hall-Mark Electronics and LSI Logic. Place-and-route layout will now be performed by the vendors, followed by final simulation and, if necessary, further refinement of the design by NRAO engineers. Approval for fabrication of prototype chips is anticipated in about six weeks.

Construction Status - The final outfitting of the Los Alamos antenna is planned to start in May. Scheduled after that is the outfitting of the North Liberty, IA site in mid-summer. Antenna erection at Owens Valley, CA, the sixth VLBA site, continues. The Brewster, WA antenna erection is planned to follow in late spring. Acquisition of the remaining sites, St. Croix, VI and Mauna Kea, HI, is now largely complete. Construction contract bidding for the St. Croix, VI and Hancock, NH sites is underway.

K. STETTEN

CALL FOR PROPOSALS FOR USE OF OPERATIONAL VLBA ANTENNAS

The Pie Town VLBA antenna has been operational for some time and is used heavily during VLBI Network observing runs. The Kitt Peak VLBA antenna will soon become operational, and is expected to see heavy VLBI Network use. Additional VLBA antennas will become operational during 1990. Beginning in late summer or early fall, 1989, limited observing time on operational VLBA antennas outside of VLBI network runs will be made available to the astronomical community for single-dish observing and interferometry. The total time available for astronomical projects may amount to about 10 percent of non-Network time, and will be limited by test time needs of the VLBA staff, the small size of the VLBA operations staff, and preparations for VLBI Network runs.

Astronomical projects can request one or more operational VLBA antennas. Pie Town has receivers at 0.3, 0.6, 1.5, 2.3, 4.8, 8.4, 10.7, 15, and 23 GHz. Other antennas will initially have receivers only at 1.5, 4.8, and 23 GHz. Proposers should be aware that data acquisition capabilities are still very limited. Since the VLBA correlator will not be available until 1991, proposers of interferometry projects must present a viable plan for correlation at existing facilities. Single-dish projects will be limited by the lack of a spectrometer and the lack of any beam switching capability. Spectroscopy can be done by recording on a VLBI tape and autocorrelating on a VLBI correlator. As for interferometry, proposers of such observations should include a processing plan. Proposals for projects that assist in testing of the VLBA will be especially welcome.

In no case will it be possible to modify VLBA hardware to accommodate an astronomical project. If a project involves specialized hardware provided by the user (e.g., pulsar observing), that specialized hardware must use signals readily available from the VLBA hardware. VLBA personnel will not operate that specialized hardware.

Proposal deadlines and observing periods will be identical to those for the VLA advertised elsewhere in this Newsletter, except for a special deadline of 15 May 1989 for projects initiated before late October. Proposals will be refereed. Observing time will be granted by the VLA/VLBA scheduling committee on the basis of scientific merit and technical feasibility, without regard to the national affiliation of the proposer(s). All proposals must be submitted with a VLBA Observing Application Cover Sheet, copies of which can be obtained from R. J. Havlen at the Array Operations Center in Socorro. Those requesting a VLBA cover sheet will also be mailed a short summary of the characteristics of the VLBA antennas which are operational, or are expected to be operational, for the next proposal period. Contact J. M. Wrobel at the AOC if further information is needed. Proposals are to be sent to: Director, NRAO, Edgemont Road, Charlottesville, VA 22903-2475.

We repeat that this call for proposals relates to time on operational VLBA antennas outside of VLBI Network runs. Proposals for VLBI Network time that include requests for operational VLBA antennas should continue to be sent to the VLBI Network.

J. M. WROBEL, R. J. HAVLEN

VLBI SUPPORT SERVICES AT THE VLA AND THE VLBA

One year ago the NRAO had to reduce the level of support for VLBI observations at the VLA because of budget cuts. Since then the Pie Town antenna of the VLBA has become operational and is used routinely for Network observations. The need for more support for such observations has been apparent, and Joan Wrobel joined the staff on 1 March to provide support for VLBI observations at both the VLA and the VLBA. The major responsibilities have been redistributed: Pat Crane will be responsible for supporting Network Mk III observations at the VLA and Joan Wrobel for all other Network observations at the VLA and the VLBA. Craig Walker and Anton Zensus will provide additional support if necessary, and the VLBA and VLA operations groups headed by Susan Koski and Phillip Hicks, respectively, will provide logistical and operational support.

The installations of the 90 cm, 3.6 cm, and 1.3 cm receivers have been completed. The new 1.3 cm receivers are a great improvement, and in-absentia phased-array observations at 1.3 cm are now allowed. In-absentia phased-array observations at 90 cm are still not feasible.

We have identified two problems that potentially affected all VLBI observations with the VLA in 1988:

1. The new on-line system did not properly disable the system-temperature correction when a T appeared in column 70 on the source card. The effect was that the correction remained enabled but the scaling for each antenna was altered. The calibration data we provided for phased-array VLBI observations, consequently, were in error. The corrections applied to the data were written on the VLA archive tapes, and in principle the VLBI calibration data could not be redetermined.

2. Based upon limited reports for single-antenna observations and our own fringe checks between the VLA and the VLBA, at least since November 1988, the Fluke synthesizer used in the signal path for single-antenna left-circularly polarized VLBI observations at the VLA (90 cm, 18 cm, 6 cm, and 1.3 cm not 3.6 cm) has been set erratically to frequencies in error by a few Hertz. Fringe-rate offsets of 0, 1, and 4 Hz have been reported for a small number of experiments. This problem has now been repaired.

P. C. CRANE

VLA

VLA CONFIGURATION SCHEDULE

Configuration	Starting date	Ending date	Proposal Deadline
B	10 Mar 1989	03 May 1989	15 Oct 1988
B/C	12 May 1989	30 May 1989	15 Oct 1988
C*	02 Jun 1989	25 Sep 1989	15 Feb 1989
C/D	06 Oct 1989	23 Oct 1989	15 Feb 1989
D	27 Oct 1989	15 Jan 1990	15 Jun 1989
A	09 Feb 1989	21 May 1990	15 Oct 1989
A/B	01 Jun 1990	18 Jun 1990	15 Feb 1990

The Maximum antenna separations for the four VLA configurations are: A 36 km, B 11 km, C 3 km, D 1 km.

* The C Configuration will be modified, by removing two anntennas from the center of the array, to reduce shadowing at the declination of Voyager.

Approximate Long-Term Schedule

	Q1	Q2	Q3	Q4
1989	A	B	C	D
1990	A	A	B	C
1991	D	A	B	B,C
1992	C	D	A	A,B
1993	B	C	D	A

Observers should note that in the ensuing years of sunspot maximum, daytime observations at 327 MHz are unlikely to be successful in the smaller configurations. In particular, C configuration observations near 8 hours RA and D configuration observations near 17 hours RA should not be proposed.

W. M. GOSS

A WARNING ABOUT ERRORS IN IMAGES OF LARGE FIELDS

For those VLA users who must determine accurate positions at large distances from the phase center, a new problem has come to light. For the more casual observer, and those with only small fields, this problem is not important.

VLA data is taken using coordinates of date, while an image is required using coordinates of epoch. To make the conversion, commonly known as differential precession, a matrix is generated at new source time that can be used to rotate the uv coordinates for each time-stamp as the data is written to tape. It has always been the case at the VLA, and still today, that this matrix includes only the effect of precession. In particular, nutation and annual aberration are not accounted for. Diurnal aberration is also ignored, but is too small to be of concern here. It has recently been noted that this is not sufficiently accurate. A rotation in the image of as large as an arc minute may remain; at the edge of the L-band primary beam this will result in a linear displacement of about 0.5 seconds. In addition, aberration will introduce a distortion of the field of perhaps comparable magnitude that cannot be expressed as a rotation.

It is not yet clear to us how best to deal with this. For the moment we will do nothing other than to provide a warning When action is taken it will be announced here. To fully account for the effects is more work than we are willing to invest at the moment; to only partially account for it is easy but is liable to lead to more confusion in the case of multi-epoch data than is necessary.

These effects can be eliminated in the following manner: First, run the AIPS task UVFIX on the u-v data in order to recompute the precise values of u, v, w, at the standard epoch. The image made from this data will be oriented precisely. Your database must include an accurate antenna file and the calendar date associated with the data must be correct (DBCON changes the day number!!). Second, to determine the distortion (stretching or shrinking) as any location in the image, consult The Astronomical Almanac, Section B21, Differential precession and nutation and Differential aberration. Only use the terms which correspond to stretching but not rotation. For more information, contact Ed Fomalont, NRAO, Edgemont Road, Charlottesville, VA 22903-2475.

K. SOWINSKI

VLA INTEGRATION TIME RESTRICTIONS IN THE POST DEC-10 ERA SPECTRAL LINE AND CONTINUUM

Even after the DEC-10 is replaced, the restrictions spelled out in the 1988 Clark and Ekers memo will remain in force. The reason is that the second Convex in Socorro essentially has the capacity of the Pipeline, which will also be decommissioned. Therefore, our net resources are not significantly increased and the same restrictions as before must be applied. The restrictions will also apply to continuum observations.

We are reluctant to impose any restrictions, but the scarce resources of the VLA computing must be allocated in a fair manner. Thus these rules should not be viewed as restricting scientific activity, but as an attempt on our part to force VLA users to consider their real needs. Many users in the past have routinely used integration times much shorter than is required. If there are good scientific reasons to exceed the restriction, exceptions can be made. Following is a restatement of the rules:

1. The basic limitation is that the product of the number of correlator channels and the number of baselines, divided by the Modcomp integration time must be less than 375. Examples are given below. The number of correlator channels is the total number of correlations made simultaneously, over all frequencies, polarizations, and IF's.

2. This limitation only applies to observations which are intended to be reduced at the VLA or at the AOC in Socorro.

3. This limitation only applies to source scans and long calibrator scans. Shorter integration times on short calibrator scans are allowed.

4. Any user with a good scientific case may appeal to Miller Goss or Barry Clark for exceptions. They are the only people authorized to lift the restrictions.

The following tables give the maximum number of antennae that may be used for a given number of IF's or frequency channels and integration time.

CONTINUUM

No. IF's\Int. time	3	5	7	10
2	22	*	*	*
4	18	22	*	*

SPECTRAL LINE

No. chs\ Int. time	3	5	7	10	20	30	40	60	80	120	240	280
4	22	*	*	*	*	*	*	*	*	*	*	*
8	18	22	*	*	*	*	*	*	*	*	*	*
16	13	16	18	22	*	*	*	*	*	*	*	*
32	8	11	14	16	22	*	*	*	*	*	*	*
64	7	8	10	11	16	18	22	*	*	*	*	*
128	5	6	7	8	11	14	16	18	22	*	*	*
256	3	4	5	6	8	10	11	14	16	18	*	*
512	3	3	4	4	6	7	8	10	11	14	18	*

* = all antennae

The number of channels in spectral line mode is the total number, i.e., summed over all IF's in use.

We urge users to feel no obligation to follow these limits, i.e., longer integration times are often a sensible choice. In the C and D array, integration times of at least one minute are suitable, while 10 seconds averaging in the B array (the continuum default) is often not necessary. It should be pointed out that a smaller body of data not only increases the chances of finding enough disk space, but also cuts down the amount of CPU and real time required to reduce the observations.

A. H. ROTS

VLA SPECTRAL LINE FREQUENCIES

From the beginning of February 1989 till the beginning of April 1989, there has been a mistake in the on-line calculation of channel separations. The only observations NOT affected are continuum observations and spectral line observations using single-IF mode and no on-line Hanning smoothing.

All observations have been done at the right frequencies and with the correct channel separations. However, on reading the Modcomp tape, FILLER and FILLM would have interpreted the channel separation parameter as indicating a frequency increment that is two or four times too small. Still, the reference frequencies in one's (u,v)-database may also be wrong since programs like FILLM and UVFITS often change the reference pixel and thus have to calculate a new reference frequency using the frequency increment.

It is suggested that you check your frequencies and frequency increments as they are retrieved from FITS and Archive tapes for the relevant period and correct them appropriately.

A. H. ROTS

VLA COMPUTER TARGET DATES

As announced, the NRAO will be receiving a third CONVEX C-1 computer to be situated at the Array Operations Center in Socorro. The target date for full operation of this system is May 15, 1989.

These expanded resources will allow us to decommission the DEC-10 and the Pipeline system. For financial reasons, we would prefer to do this as soon as possible after the new computer is operational. The planned date is June 30, 1989. This is a reminder that, as of this date, all DEC-10 backup tapes will be unprocessable.

G. C. HUNT

REPLACEMENT FOR "OBSERV" ON THE DEC-10

The replacement (OBSERVE) for the observation preparation program (OBSERV) is under development by Al Braun. He is writing it in ANSII C, and it will run initially on VAXES and PCs. The target date for the first major release is May 1, 1989, well in advance of the scheduled date for the termination of the DEC-10 (June 30). A later development will also allow OBSERVE to be run on UNIX-based computers. Extensive testing by the NRAO scientific staff progress.

G. HUNT, R. BRAUN

PULSAR OBSERVING

The development of facilities for pulsar observing has been progressing well. By operating the VLA in "phased-array" mode, then sampling the detected "analog sum" signals (usually used for VLBI), we have been able to construct average profiles of pulsars and gate the correlator synchronously with a selected portion of the pulse period. We have made successful gated pulsar observations in both the continuum and spectral line modes. Substantial progress has been made on development of a polarimeter "backend" for the Mk III VLBI filter bank. When complete, we will be able to obtain pulsar polarization profiles from each filter bank channel. By combining these profiles after appropriate delay and Faraday rotation compensation, we will be able to reconstruct profiles with considerably better time resolution than is now possible.

T. H. HANKINS

AIPS SUPPORT AT AOC

Two new AIPS members have arrived at the AOC: Chris Flatters (AIPS programmer) and myself, Bill Junor (AIPS manager). We have been recruited to improve AIPS support for both NRAO staff and visiting users. If you have problems or questions regarding the reduction of your data within AIPS at Socorro, you should contact me: Room #208 in the AOC (505) 835-7210.

W. JUNOR

PLANS FOR AN NRAO CONFERENCE ON INTERFEROMETRY

In October 1990, NRAO is planning to host a conference in Socorro entitled "Radio Interferometry--Theory, Techniques and Applications," probably during the week of October 8-12. This coincides with the tenth anniversary of the NRAO's Very Large Array radio telescope. The emphasis of the meeting will be on the technical aspects of radio-interferometry rather than astronomical results. We believe that since this topic has not been addressed by a conference in recent years, and that, given the large number of arrays either being designed or built, the time is ripe for such a conference.

A preliminary outline of the meeting includes the following topics:

THEORY:
- Normal theory of interferometry, especially unusual formulations
- Extensions of the theory to unusual circumstances (bright objects, non-coplanar arrays, near-field imaging, or spatially coherent objects)
- Array configuration design

HARDWARE:
- Antenna and feed design for interferometry
- RF/IF design for interferometry (receivers, IF path)
- Correlators (sampling and digitization, FX versus XF correlator designs)
- Special-purpose devices (for imaging)

TECHNIQUES AND APPLICATIONS:
- Calibration, (radio seeing, polarization, spectral-line)
- Imaging (deconvolution, self-calibration, mosaicing, bandwidth synthesis methods)
- Display (3-D displays of spectral line data)
- Geodesy
- Radar imaging using synthesis arrays
- Astrometry
- Applications of interferometric techniques to single-dish imaging

RADIO-INTERFEROMETRIC ARRAYS:
- New arrays (VLBA, AT, IRAM, GMRT, Nobeyama array, BIMA)
- Future arrays (NRAO MMA, Quasat, Radioastron, NRL arrays, lunar-based systems)

In addition to these topics, we also plan a discussion of the design and construction of the VLA, which would be interesting and appropriate for the tenth anniversary of the VLA dedication.

We are now seeking sponsorship for the meeting from IAU and URSI. We expect to send out a more detailed notice later this year. Meanwhile, we would be interested to receive any comments.

T. J. CORNWELL, R. J. HAVLEN

VLA VISITOR CENTER RENOVATION

After six years of operation at the VLA and an average visitor rate of more than 1000 per month, the VLA Visitor Center has undergone a major face lift. The dry New Mexico climate over the years had taken its toll on the original photographic displays. Mediaworks from Albuquerque, NM was contracted for the design and installation of new displays, and several NRAO staff provided invaluable assistance in developing the new presentations (Spargo, Leahy, Rots, and Chavez, to name only a few).

Major funding for the effort came from Associated Universities, Inc., with contributions from NASA/JPL and the VLBA project.

Included in the face lift is a spectacular mural of the outer solar system, a model of Voyager 2, and video information about the August 1989 Neptune Encounter. Most of the astronomical images have been updated to reflect the output of the VLA since the original displays were installed in 1983. The introductory slide show has been transcribed into a video format. Another video display introduces the visitor to the rudiments of VLA image creation and processing. Last but not least, a new display highlights the VLBA project.

We hope that each of you will take the opportunity to enjoy the new Visitors Center during your next visit to the VLA. Please spread the word to any would-be travelers to New Mexico that you may know.

R. J. HAVLEN

VISITOR ACCOMMODATIONS IN SOCORRO

Since the NRAO established operations at the Array Operations Center (AOC) in Socorro in December, 1988, scientific visitors to the AOC have been lodged at two locations. Six temporary guest rooms, although spartan, have been very popular. Six additional rooms located in Fitch Hall dormitory at New Mexico Tech are more convenient from the AOC. None of the rooms has a private bath; the nightly room rate is $15 ($9 for students).

Reservations for these rooms and for the Socorro shuttle (Albuquerque-Socorro transport service) should be arranged with Donna Silva [(505) 835-7357 or through E-mail-Dsilva @ NRAO, or through Span- NRAO::dsilva] at least two weeks prior to your visit.

R. J. HAVLEN

VLA ARCHIVE PROGRAM

The calibrator and archive program for the IBM PC has been updated. Archive data up to the end of 1988 are included as well as the most recent copy of the calibrator list. There are two sets of archive data available. The LONG set includes summaries of all observations longer than 10 minutes duration and requires about 6 Megabytes of disk space (it is distributed on six 360k (or two 1.2M) 5-1/4" floppy diskettes). The SHORT set includes summaries of all observations greater than one hour duration and will require about 3 Megabytes of disk space (this data is distributed in four 360k (or one 1.2M) 5-1/4" floppy diskettes).

If you wish to obtain a copy of the program and data, send your request to:

Sandra Montoya
NRAO, P. O. Box O
Socorro, NM 87801

and specify either the SHORT or LONG data set as well as 360k or 1.2M 5-1/4" floppy diskette. Please send diskettes if possible.

R. C. BIGNELL

12-METER

NEW ERROR-CORRECTING SUBREFLECTOR

In late January, we installed a new error-correcting subreflector, manufactured for us by John Davis and Charlie Mayer of the University of Texas. The subreflector corrects for small-scale surface errors as well as for large scale deformations that produce astigmatism, for example. The subreflector shape was calculated from holography maps of the 12-m surface produced last summer. This version of the subreflector is different from the one installed last year in two respects. First, the new subreflector was based on a 65 x 65 grid-point holographic map whereas last year's was based on a 33 x 33 grid. In addition, last year's subreflector was suspected to have deformed after a few months, apparently as a result of creep in the metal. With the new subreflector, we took special care to temper and reinforce the metal, and are confident that it will not lose its shape. The subreflector has been in use for two months now with no evidence of any degradation in performance. Based on observations of the 345 GHz J=3-2 CO line wings of the Orion OMC-1 outflow source, the new subreflector has improved the gain of the telescope by about 50 percent, similar to the improvement initially noted last year. In addition, the beam shape is even cleaner than with last year's subreflector, and has a FWHM at 345 GHz of 20", which is approximately what is expected from a theoretical diffraction beam at that frequency.

D. T. EMERSON, P. R. JEWELL, J. S. KINGSLEY

HYBRID SPECTROMETER

On Monday, April 3, the Hybrid Spectrometer was moved from the Tucson laboratory to the 12-m telescope on Kitt Peak. The initial period of testing and evaluation will be conducted by staff members. If the spectrometer is performing acceptably, it will be configured to run in parallel with the existing filter bank spectrometers. At this stage, observers will be able to examine and compare the data from the new spectrometer and the filter banks, and provide feedback to the staff on the operation of the instrument. The spectrometer has 1536 spectral channels that can be divided among 8 independent I.F. sections. The spectral resolution can range between 24 kHz and 1.5 MHz. The maximum possible bandwidth will be 2.4 GHz, although the current generation of receivers is limited to bandwidths of 600 MHz.

D. T. EMERSON, P. R. JEWELL, A. V. DOWD

MILLIMETER-WAVE VLBI

We have just completed a 3 mm VLBI run with Nobeyama, Hat Creek, Owens Valley, and Onsala. Alan Rogers, Mel Wright, and local staff members manned the 12-m station. None of the tapes has been processed yet, but the observations went smoothly. From the run performed a year ago, fringes were detected on all baselines with a resulting angular resolution of 50 micro-arcseconds, by far the highest resolution ever obtained in an astronomical observation. This year, for the first time, we also attempted VLBI at 1.3 mm between Owens Valley and Kitt Peak. The equipment appeared stable, but unfortunately, the weather was poor at both sites. Nevertheless, stay tuned ....

D. T. EMERSON, P. R. JEWELL,
J. W. LAMB, A. A. PERFETTO

IN GENERAL

1989 JANSKY LECTURER

It is a pleasure to announce that Professor Joseph H. Taylor of Princeton University will be the 1989 Jansky Lecturer.

Professor Taylor is well known for his pioneering research on pulsars. The extensive pulsar surveys conducted by Professor Taylor and his colleagues have provided important measures of the origin, lifetime, evolution, and spatial distribution of pulsars in the Galaxy. His discovery that pulsars are occasionally found in binary systems permitted the first direct measurement of pulsar masses to be made. An extreme example of the binary phenomenon, the close binary 1937+21, has been used by Professor Taylor to demonstrate, empirically, the existence of gravitational radiation.

The Jansky Lectureship is awarded annually by Associated Universities, Inc., to a distinguished scientist who has made outstanding contributions to the field of astronomy or a related subject. William H. Fowler of the California Institute of Technology was the 1988 Jansky Lecturer.

P. A. VANDEN BOUT

NO POACHING!

Allocations of observing time on NRAO telescopes are made on the basis of scientific merit, determined by anonymous referees for proposals from Observatory staff and visitors alike. This system is critical to the scientific productivity and success of NRAO. The integrity of the system is violated when a user makes observations not included in her or his proposal. Users are reminded of the absolute necessity of consulting with the site director and obtaining approval before altering scheduled observing programs. Approval can be granted under those circumstances which do not lead to an infringement on work proposed by others.

P. A. VANDEN BOUT

ANALYZ AT THE NRAO

One of the many advantages of our plan to move single-dish analysis to a UNIX workstation environment at both the 140-ft and the 12-m telescopes is that we will be able to support a wider variety of user-supplied software. As an initial step in this direction we wish to respond (albeit somewhat belatedly) to the requests of those users wishing to have the NAIC software package ANALYZ running at the NRAO. For this to happen we will need the cooperation, and indeed the help, of the interested ANALYZ users.

Soon, we would like to meet with prospective ANALYZ users in order to assess (1) priorities and the scale of the undertaking; (2) hardware and ancillary software needs; and (3) manpower available outside the NRAO for this project. NRAO users who would like to be involved in molding our application of ANALYZ should contact me.

ANALYZ is but one example of a software package that can be "ported" to the NRAO by and for interested users. There may be others. If so, and if the ANALYZ project proceeds expeditiously, I would appreciate hearing about similar user needs and opportunities to augment our single-dish software capabilities.

R. L. BROWN

EDITOR NRAO NEWSLETTER
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