



# NRAO NEWSLETTER

1986 October 1

No. 29

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## VLBA

### PROGRESS ON THE VLBA

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A further shift in the order of station construction has been made to reduce wintertime construction and antenna erection activities in northerly locations. The order now is: (1) Pie Town, NM, (2) Kitt Peak, AZ, (3) Los Alamos, NM, (4) North Liberty, IA, (5) Fort Davis, TX, (6) Brewster, WA, (7) St. Croix, USVI, (8) Owens Valley, CA, (9) Mauna Loa, HI, (probably) (10) Northeast site, not yet fixed.

At Pie Town, the antenna foundation is complete, the alidade track has been aligned and grouted in place, and the pintle bearing has been set. Much of the antenna structure is on site, and assembly is proceeding on schedule. The control building is under roof, and partitions and shielding are being installed. Progress indicates that this antenna will be ready for acceptance tests by mid-December. Manufacture of the next three antennas is on schedule.

At Kitt Peak, pouring of the antenna foundation is in progress. The control building walls are up, and plumbing is being installed, ready for pouring of the floor slab. The Los Alamos construction contract is in place, excavation is starting, and concrete pouring will begin shortly. North Liberty (Iowa) construction drawings are complete, and bids for the foundation will be due October 28. The survey and soils tests at the Ft. Davis, TX site are nearly complete. NRAO is negotiating for a good site for the St. Croix station, on land owned by Fairleigh Dickinson University.

Design and manufacture of feed cones, subreflectors, and focus-rotation mounts (FRM) are progressing well. The first feed cone is now at the VLA, being outfitted with feeds and the first set of NRAO-built receiver electronics. It will be installed on the Pie Town antenna in November. The first FRM is expected late this year, and will also be outfitted at the VLA prior to installation.

The three electronics racks for the Pie Town station were shipped in late September to the VLA for overall system tests in conjunction with the Station computer and other elements of the Monitoring and Control (M/C) system developed at the VLA. Front ends include 15-, 10.7-, 4.8- and 1.5 GHz cooled units, and the 330/610-MHz room temperature unit. Racks for the Kitt Peak electronics are in hand, and building is in progress. Construction of electronics for the later stations will be paced by funding limitations. While receivers are provided for Pie Town at most of the planned frequencies in order to prove out the antenna and other equipment designs, later stations will initially have receivers only at 1.5, 4.8 and 23 GHz.

By agreement with Haystack Observatory, the first prototype electronics rack (DAR1) of the Data Acquisition System, and its accompanying recorder (RECI), now under construction, are now scheduled to be available to NRAO in January, 1987 for test and installation at Pie Town. The delay is due to problems in meeting certain VLBA specifications.

Refinement of the conceptual design of a spectral-domain ("FX") correlator for the VLBA continues, toward the complete characterization necessary for deciding whether to adopt such an architecture. There is considerable momentum in the analytic studies and computer simulations, and in the development of a gate-array design which would be used extensively in such a correlator.

Paul Sebring

## VLBI

### NRAO JOINS U.S. VLBI CONSORTIUM

The NRAO has joined the U.S. VLBI Consortium as an Associate Member. The Consortium consists of the U.S. observatories which regularly participate in VLBI research. The present membership includes: Agassiz Radio Astronomy Station (Harvard), Hat Creek Observatory (U.C. Berkeley), North Liberty Radio Observatory (Univ. Iowa), Owens Valley Radio Observatory (Caltech), Maryland Point Observatory (Naval Research Labs.), Deep Space Network (JPL), Institute for Astronomy (Bologna), and MPI fur Radioastronomie (Bonn). The Consortium oversees and coordinates the U.S. VLBI Network, which schedules four observing sessions per year. The 140-foot telescope at Green Bank and the VLA regularly participate in Network sessions.

R. L. Mutel

## VLA

### VLA CONFIGURATION SCHEDULE

I. 1986/87			
<u>Quarter</u>	<u>Configuration</u>		<u>Proposal Deadline</u>
1986 Q4	B/C, C	[16]	June 15, 1986
1987 Q1	C, C/D, D	[18]	September 15, 1986
1987 Q2	D, D→A, A	[20]	December 15, 1986
1987 Q3	A	[22]	March 15, 1987

Maximum antenna separation for the four VLA configurations are: A-36 km, B-11 km, C-3 km, D-1 km. Further information is summarized in the "VLA Observational Status Report," which can be obtained from Alison Patrick, National Radio Astronomy Observatory, P. O. Box 0, Socorro, New Mexico 87801, Telephone: (505) 772-4240.

D→A is the move from D to A and is only suitable for point source observations.

[ ] indicates the number of antennas available at 327 MHz.

### II. APPROXIMATE LONG-TERM SCHEDULE

	<u>Q1</u>	<u>Q2</u>	<u>Q3</u>	<u>Q4</u>
1986	D	A	B	C
1987	C	D	A	B
<sup>#</sup> 1988	B	C	D	A
<sup>+</sup> 1989	A	B	C	D

<sup>#</sup> All antennas equipped for 327-MHz operation.

<sup>+</sup> All antennas equipped for 8.4-GHz operation.

R. Ekers

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VLA HOSTS VISITS FOR CONGRESSIONAL AND NSF STAFF MEMBERS

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On 20 August 1986, the VLA and VLBA Pie Town sites were visited by Dick Malow, Chief Aide for Representative Boland, House of Representatives Appropriations Subcommittee for HUD-Independent Agencies; Ray Bye, Representative for the NSF Congressional Liaison Office; and Ludwig Oster, NSF Project Officer.

Joel M. Widder, Senior Legislative Analyst with NSF's Office of Legislative and Public Affairs, and a number of Congressional Committee staff members from the House and Senate with oversight responsibilities for the National Science Foundation, visited the VLA on 25 August 1986.

Committees represented were:

- House Science and Technology
- U.S. House Committee on Budget
- U.S. Senate Committee on Budget
- Subcommittee on Education, Arts and the Humanities on Labor and Human Resources

Visiting from the NSF on 4 September were: Erich Bloch, Director; William Merrell, Assistant Director for Geo Sciences, and L. Pat Bautz, Division Director for Astronomical Sciences. Their visit included stops at the VLA, the VLBA building and the Pie Town site.

R. D. Ekers

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NOTES ON SYNTHESIS IMAGING

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The course notes from the NRAO Summer School on Synthesis Imaging are now available.

The NRAO Summer School on Synthesis Imaging was held in Socorro from August 5 to August 9, 1985. The main purpose of the course, like that of its predecessor in 1982, was to inform potential users of the VLA and VLBA about the principles on which synthesis radio telescopes operate; about the subtleties of data acquisition, calibration and processing associated with them; and about techniques for getting the best results from them. It is aimed primarily at radio astronomers who are relative newcomers to the field of synthesis imaging--e.g., at beginning graduate students or those whose expertise is primarily in observations at shorter wavelengths, to astrophysicists who wish to interpret the data from synthesis telescopes, and to researchers employing Fourier methods or deconvolution techniques in other fields of imaging.

The 278 pages of notes contain the full text and illustrations for 16 lectures by NRAO staff members, covering the following topics: Introduction and Basic Theory (B. G. Clark), The Interferometer in Practice (A. R. Thompson), Cross Correlators (L. R. D'Addario), Calibration (R. C. Bignell and R. A. Perley), Imaging (R. A. Sramek and F. R. Schwab), Sensitivity (P. C. Crane and P. J. Napier), Deconvolution (T. Cornwell), Special Problems in Imaging (W. D. Cotton), Self-Calibration (T. Cornwell), Error Recognition (R. D. Ekers), Very Long Baseline Interferometry (R. C. Walker), Image Analysis (E. B. Fomalont), Data Display (A. H. Rots), and VLA Observing Strategies (A. H. Bridle).

Copies of Synthesis Imaging are obtainable from: NRAO, Attn: Carol Ziegler, P. O. Box 2, Green Bank, WV 24944. The cost for each volume is \$10 (shipping included); payment must accompany each order.

R. J. Havlen

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VLA PROPOSAL SUBMISSION STRATEGY

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Submit your proposals well before the deadline given for your desired configuration(s) (i.e., at least the quarter before). The following statement was printed in a previous issue of the AIPS Newsletter.

The deadlines and the VLA configuration schedule are published regularly in the NRAO Newsletter and in the AAS Newsletter. Proposals may be submitted between the deadline dates, and indeed NRAO encourages this for several reasons: (a) the pressure of proposals for a given configuration influences the length of time that the VLA is scheduled to spend in that configuration, (b) early submission may give you a chance to reply to unfavorable referees' comments before the scheduling committee assigns time for the requested configuration(s), and (c) observers who submit early reduce the strain on the proposal processing system near the time of the deadline.

R. J. Havlen

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VLA COMPUTER OPERATIONS

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The VLA has extended the computer operator shift coverage to include weekend day shifts. Shifts now covered (except for NRAO holidays) include:

Sunday through Saturday	0830 to 1630 hours
Monday through Friday	1600 to 2400 hours

Operators may be contacted at extension 254, or at the Control Building office No. 203. All problems regarding computer operations, tapes, printouts, etc., should be brought to the computer operator's attention. The computer operators cannot provide help with VLA data reduction strategies or details of program operation.

Jon Spargo

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RECENT VLA MEMORANDA

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Recent additions to the growing library of numbered VLA Memoranda include the following:

Technical Report No. 58:	Dataset Module Type M1	(D. Weber)	August 1986
Technical Report No. 59:	The Antenna Buffer Module Type M4	(D. Weber)	July 1986
Technical Report No. 60:	The Central Buffer Module Type M3	(D. Weber)	August 1986
Technical Report No. 61:	The System Buffer Module Type M14	(D. Weber)	June 1986
Scientific Memorandum No. 157:	Atmospheric Opacity at the VLA	(J. Uson)	February 1986.

Two technical reports are currently underway and should become available within the next month or two. They are:

Technical Report No. 62:	The Command Simulator Module Type M5	(D. Weber)
Technical Report No. 63:	The Serial Line Controller	(D. Weber).

If you would like a copy of the listings of VLA Memoranda or a copy of any of the ones previously issued, contact Alison Patrick at the VLA, P. O. Box 0, Socorro, NM 87801 (505) 772-4240.

Alison Patrick

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IRAS SKY BRIGHTNESS IMAGES AVAILABLE AT THE VLA

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The IRAS Sky Brightness Images (HCON 1) are available at the VLA in FITS format on magnetic tapes stored in SLOB room 12. These tapes contain images of 212 fields that cover the entire celestial sphere. The fields are 16.5 degrees on a side and have been imaged in each of the four IRAS bands with 2 arcminute pixels and 4-6 arcminute resolution. These FITS images can be loaded to disk with the AIPS task IMLOD. For assistance in using these tapes at the VLA, consult the undersigned or R. Braun. For further details regarding the Sky Brightness Images see IRAS Catalogs and Atlases, Explanatory Supplement (1985, eds, Beichman, C. A. et al., Washington, D. C.: U.S. Government Printing office).

J. M. Wrobel

## 12-Meter

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NEW ASSISTANT DIRECTOR FOR TUCSON OPERATIONS

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Dave Hogg will be returning to the basic research staff in Charlottesville following eighteen months as director of Tucson operations. I want to thank him on behalf of the Observatory and the millimeter astronomy community for the excellent leadership he provided.

It is a pleasure to announce the appointment of Dr. Darrel Emerson as Assistant Director, Tucson Operations, effective 1 January 1987.

Dr. Emerson comes to the NRAO from IRAM in Grenoble, France, where, in addition to his astronomical research on nearby galaxies, he has been involved with the development of the control and analysis software for the IRAM millimeter-wave interferometer.

Dr. Emerson received his Ph.D. degree from Cambridge University working in Professor Ryle's group under the immediate direction of Dr. John Baldwin. Upon completion of a postdoctoral fellowship, also at Cambridge, he joined the MPIfR in Bonn as astronomer and leader of the Effelsberg telescope control group. He left the MPIfR for IRAM when the millimeter-wave interferometer construction project began.

Dr. Emerson is an expert in telescope control and astronomical mapping techniques, and we welcome his leadership in Tucson.

P. A. Vanden Bout

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SCHOTTKY MIXER RECEIVERS

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70-120 GHz Receiver

During the shutdown period the klystron local-oscillator system in this receiver was replaced with Gunn oscillators. The phase-locking circuits perform well, and this modification should increase the reliability of the receiver and greatly reduce operating costs.

200-270 GHz Receiver

This receiver is also being modified to replace the klystrons with Gunn oscillators. The receiver will be installed on the telescope in November with two channels covering 200-270 GHz. The noise temperature of the receiver varies from 500K SSB to 1100K SSB over this frequency range.

270-310 GHz Receiver

A mixer and tripler for this band are being developed in the Central Development Laboratory. We hope to mount these devices as a single channel receiver, and are striving to have it available for the upcoming high-frequency observing season. Ultimately we will add this band, as a dual-channel receiver, to the 200-270 GHz receiver box.

### 330-360 GHz Receiver

The local oscillator in this receiver is being replaced with a Gunn oscillator and quadrupler. The receiver is a single channel at the present time and expansion to two channels may be possible in the future if sufficient LO power is available.

### 8 Feed, 230 GHz Receiver

The construction of the four-feed prototype receiver for this project is almost complete, and we hope to test it on the telescope early next year. The receiver is designed to cover the frequency range 220-230 GHz and will have four beams in a line, with a beam separation of 80 arcseconds. A single Gunn oscillator provides LO power for the four feeds and expansion to 8 feeds will simply consist of duplicating the existing system.

J. M. Payne

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### SIS RECEIVER

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The new niobium junctions fabricated by the Central Development Laboratory have been incorporated into this receiver during the quarter. The noise temperature is now less than 100K SSB at 115 GHz, with an image rejection of about 20 dB. The aperture efficiency is now around 45%, a similar value to the Schottky receiver.

J. M. Payne and J. Lamb

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### READJUSTMENT OF THE 12-METER SURFACE

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In August 1986, J. W. Findlay, P. Rhodes, and E. Stobie completed a mechanical measurement of the 12-meter telescope surface which showed agreement with the measurement made in August 1985 to within an rms of 30 micrometers, indicating that the surface and backup structure are very stable over time. Encouraged by this, we elected to reset the 30 outer panels having the largest deviation from the best-fit surface. A remeasurement of the adjusted surface showed that, on the basis of the mechanical measurement, a substantial improvement had been achieved. The estimation of the effective surface rms will be made radiometrically using the high frequency receivers when they are installed on the telescope later this fall.

We anticipate that it will also be useful to make another measurement of the surface using holography, probably late next spring.

D. E. Hogg

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### ACTIVITIES DURING SUMMER SHUTDOWN

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In addition to the usual minor repairs and refurbishment of the telescope, a number of other projects were started. Of particular interest to observers is the optical telescope project, which we hope will lead to the capability of pointing the 12-meter optically. We expect to mount the optical system in October, with first tests in November. We also plan to install the software necessary for beam-switching in spectral line mode later this fall. Preliminary tests show that the baselines obtained using this technique are very flat. Observers may wish to use spectral line beam-switching for those objects with angular diameter smaller than the beam throw. The system was tested with a beam throw of 4 arcminutes.

D. E. Hogg

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**SCIENTIFIC ASSISTANCE WITH 12-METER OBSERVATIONS**

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Prior to their observations, prudent users of the 12-meter telescope often seek advice regarding issues such as the following: (1) observing techniques and source scheduling; (2) optimizing one's observations for the telescope; (3) availability of instrumentation at the 12-meter; (4) calibration; and (5) data analysis. Users seeking assistance with questions on such issues are encouraged to contact those members of the NRAO scientific staff who are experienced with the 12-meter telescope. In particular, Barry Turner, Al Wootten, and Bob Brown are happy to provide the information, guidance, and help required--a discussion with one of these individuals may greatly facilitate your work. Give them a call.

R. L. Brown

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**12-METER PROPOSAL DEADLINE REMINDER**

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This is a reminder of the announcement made in the last Newsletter that effective January 1, 1987, the deadlines for submission of 12-meter telescope proposals will be the following:

Period	Observing Season	Deadline
I	Mid-September to 31 December	1 July
II	1 January to 31 March	1 October
III	1 April to mid-July	1 January

Special frequency-dependent considerations include:

- The 345-GHz receiver will generally not be available in periods I or III.
- 230-GHz observations will not be scheduled before mid-November or after mid-May.
- Summer shutdown will occur between mid-July and mid-September.

R. J. Havlen

## Green Bank

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**BEAM SPLITTER FOR 140-FOOT TELESCOPE**

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Construction of the beam splitter has been completed. It has been installed on the Cassegrain house of the 140-foot telescope, where it is protected by a radome-like structure. In addition, tertiary mirrors have been mounted on the Cassegrain house.

The optics path for an incident ray now includes reflection from the primary 140-foot mirror to a secondary, then onto the beam splitter. At this device, the ray is split into orthogonally linearly polarized rays reflected to the tertiary mirrors. The tertiaries direct the rays into the feed horns of the maser-upconverter receivers. The goal is to permit simultaneous use of both such receivers, either at the same frequencies but with orthogonal polarizations or at different frequencies. Initial operation will permit use of frequencies between 7.5 and 25 GHz.

The optics system needs refined alignment. Time is scheduled during October to complete these adjustments.

Ronald J. Maddalena and Chuck Brockway

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LATERAL FOCUSER FOR 140-FOOT TELESCOPE

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We have determined the parameters of the lateral focuser which optimize the performance of the 140-foot telescope's Cassegrain system. The lateral focuser does not change the aperture efficiencies along the meridian. However, the hour angle performance of the telescope has been significantly improved. At 15 GHz, the efficiency at a given declination is constant to within ten percent over the full range of hour angles. At 20 GHz, the shape of the curve of gain vs hour angle is similar to the curve at 10 GHz before lateral focusing.

A full report discussing these results, along with the necessary changes to the pointing equation, is in preparation. Unless otherwise requested by the observer, the lateral focuser will be in use for all Cassegrain observations.

Ronald J. Maddalena and Chuck Brockway

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2.5-GHz RECEIVER: PRELIMINARY TEST RESULTS AT 4.6-5.0 GHz

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This receiver has two sections. The 2.9-3.4 GHz portion has been in use for more than a year. Here we report on final tests of the newly installed 4.6-5.0 GHz section. This dual-channel receiver utilizes a hybrid mode feed, cooled circular polarizer, and low-noise FET amplifiers. It achieves a dewar flange noise temperature in the range of 20 to 29 K across the band. A double conversion scheme uses a PLL variable LO in the first stage mixing and a fixed LO in the second stage to produce an IF centered at 300 MHz, with a bandwidth of 200 MHz. The IF can easily be switched from dual circular polarization to orthogonal linear polarization. Laboratory measurements that include the effects of the hybrid-mode feed indicate an overall receiver temperature of roughly 24 to 32 K. Based on these measurements and previous tests made of the 2-5 GHz receiver operating on the 140-foot in the 2.9-3.4 GHz band, it is estimated that 140-foot system temperatures in the 4.6-5.0 GHz band will be in the range of 30 to 39 K. The receiver can also be used on the 300-foot telescope.

Richard Bradley

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NEW 5-GHz MULTIPLE FEED RECEIVER

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A new 5-GHz continuum receiver is now available for use. The receiver has 6 dual, circularly polarized feeds arranged as a hexagon plus a central feed. The feeds are separated by about 8.2 arcminutes, or roughly three beamwidths. The receiver package can be rotated such that feeds are spaced by single half-power beamwidths. System temperatures for the fourteen receivers are between 50 and 70 K. A bandwidth of 580 MHz is detected in each front end, and the total power is digitized by A/D converters and recorded.

This receiver is currently in use on the 300-foot telescope. As reported in the last Newsletter, the lateral focusing mechanism on the 300-foot telescope is not yet operational. Its installation should be completed in early October. At the moment, then, the aperture efficiency of an individual receiver is comparable to that of the old 5-GHz receiver. Lateral focusing should provide optimal gain, now enjoyed only near zenith, for all declinations between the equator and the pole.

This receiver may also be used at the 140-foot telescope.

Harry Payne

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PRECISION TIME AT GREEN BANK

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A Precision Time Station (PTS) has been installed in the Interferometer control building. This includes a Global Positioning Satellite (GPS) receiver, a Loran receiver, two Cesium clocks, and instrumentation to monitor and log the time differences among these. The 1 PPS from the H-maser at the 140-foot control building, which is the distributed site time reference, is also monitored in this system.

State-of-the-art timing accuracy for pulsar, VLBI, and other experiments is possible with this system. The HP 9915 computer controlling the PTS may be accessed via modem and queried for the time offset of the site 1 PPS, accurate to better than 100 ns relative to the USNO standard. Additional accuracy, down to 10 ns relative to the USNO standard, may be achieved by accessing the USNO's HP 1000 in Washington. This accuracy is achieved by the common view technique, similar to VLBI, in which both sites view the same satellite simultaneously, and for which the first order error is caused by differences in the ionosphere over the two sites.

Anyone requiring additional information should contact Rich Lacasse (304) 456-2128.

Rich Lacasse

## In General

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FALL 1986 NRAO USERS COMMITTEE MEETING

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The Fall meeting of the NRAO Users Committee will be held in Green Bank on October 22 and 23. The first day of the meeting is an open session during which the status of current Observatory programs is described and future plans are presented. An important part of this day of the meeting is a discussion of priorities, as seen by the users, of the on-going research equipment program. But the discussion is by no means restricted to equipment: a full range of concerns germane to the efficient functioning of the Observatory for visiting scientists is aired. The morning of the 23rd is set aside for a caucus of the Committee members to enable them to share with the NRAO administration their views on the operation of the Observatory and their suggestions for its improvement.

Single-dish, telescope interface and spectral-line analysis software--the 300-foot control system; recent progress in POPS; the FITS export tape format; data reduction on a personal computer--will be discussed at an ad hoc workshop on the afternoon of the 23rd. All those Committee members and others interested in this subject are encouraged to participate.

The entire committee meeting, all day October 22nd, and the spectral-line software workshop on the 23rd are open to anyone who wishes to attend. Unfortunately, the NRAO can reimburse the expenses of the Users Committee members only. Individuals not on the Committee attend at their own expense.

We look forward to an interesting meeting.

R. L. Brown

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SUPERCOMPUTER WORKSHOP

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The NRAO is planning to hold a two-day meeting in Socorro in January 1987, with preliminary session titles "AIPS on Supercomputers" and "Displays and Output Equipment [for supercomputers]" The tentative date is January 20 and 21. Persons who might want to participate can contact Bob Burns at (804) 296-0229 for further information. This workshop was originally scheduled for November 19-21, 1986.

R. Burns

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NRAO POSTDOCTORAL APPOINTMENTS IN 1987

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The National Radio Astronomy Observatory offers postdoctoral Research Associate appointments which provide outstanding opportunities for research in astrophysics. The Research Associate may formulate and carry out investigations either independently or in collaboration with others within the wide framework of interests of the Observatory. A strong focus on topics in radio astronomy is desirable though not essential. Current areas of research include: cosmology, theoretical and observational studies of radio sources; the interstellar and intergalactic medium; structure and dynamics of galactic and extragalactic sources; physics of HII regions, stars, and solar system objects; and astrometry. Subgroups of the research staff are also heavily involved in instrumental development and image processing.

Appointments, which are available at any of the NRAO sites, are made for a term of two years and include a vacation allowance and other benefits. They may be renewed for one additional year. The Research Associate must have received the Ph.D. prior to beginning his/her appointment.

The Observatory will partially reimburse new Research Associates for the expense of travel and moving within the United States incurred in coming to the NRAO. Authorized travel to scientific meetings during the term of the appointment is also reimbursed.

Application may be made to:

Research Associate Selection Committee  
National Radio Astronomy Observatory  
Edgemont Road  
Charlottesville, Virginia 22903-2475

The application should include (1) a curriculum vitae, (2) the names and addresses of three references who are familiar with your work, and (3) a brief statement of the type of research activity you might undertake at NRAO.

The application deadline is January 15, 1987.

R. J. Havlen

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CHANGE IN CHARLOTTESVILLE FTS

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On September 22, 1986, the FTS number for NRAO in Charlottesville was changed to 940-7211. Callers may also dial in direct to an extension at all hours by dialing 940-7 plus the three-digit extension of the desired party.

John P. Lagoyda

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WORKSHOP ON "CONTINUUM RADIO PROCESSES IN CLUSTERS OF GALAXIES"

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A workshop on "Continuum Radio Processes in Clusters of Galaxies" was held in Green Bank from August 4 to 8, 1986. The 37 participants included X-ray, optical, and radio observers as well as theorists.

Among the topics discussed were radio surveys of clusters, narrow angle tail and wide angle tail radio sources, diffuse cluster radio halos, dominant cluster galaxies, cooling accretion flows, cluster magnetic fields, diffuse cluster emission, dynamics of clusters, and the interaction between radio galaxies and the intracluster medium. Many new results in these areas were presented. In addition, there was a lot of discussion centered on better defining the role environment plays in triggering radio emission and influencing the subsequent radio properties.

The proceedings of the workshop will be published by NRAO.

Chris O'Dea and Juan Uson

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THE NEWSLETTER MAILING LIST

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In view of mounting costs of production and distribution, we asked in the April 1 issue of the Newsletter that recipients let us know if they wanted to continue receiving the Newsletter. We have received an affirmative response from roughly half of our recipients. Since that time the company which supplies our paper has discontinued the lighter grade of paper we have been using in favor of a heavier one. Both paper costs and mailing costs have accordingly escalated. We therefore urge those individuals who have not responded to our earlier request to do so now. We will continue to send the Newsletter to all institutions currently on the mailing list. We particularly urge those recipients whose institutions will continue to receive the Newsletter to indicate whether they have need of a personal copy.

If you wish to continue receiving the Newsletter, please mail to Joanne Nance, NRAO, Edgemont Road, Charlottesville, VA 22903

The Editor

Name: \_\_\_\_\_

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