NRAO NEWSLETTER

1983 December 1 No. 15

12-Meter

STATUS OF THE 12-METER TELESCOPE

The Telescope: Measurements and resetting of the telescope are complete for the time being. Prime focus radiometric measures of Venus yield aperture efficiencies

$$\eta_A\ (90\ \text{GHz}) = 0.48 \pm 0.03$$

$$\eta_A\ (223\ \text{GHz}) = 0.19 \pm 0.03$$

where the uncertainties include those of calibration. Scaled feeds were used at 90 and 223 GHz so that the illumination pattern is identical.

These results correspond in the Ruze theory to a surface accuracy of 110 ± 10 μm. There is a possibility (Ulich, personal communication) that the flux of Venus is slightly in error and that the surface accuracy may be slightly better than 110 μm. More recent calibrations using Saturn give consistent results, however, and make this possibility unlikely. Present mechanical measurements do indicate a surface accuracy better than 110 μm. A future set of holography and mechanical measurements of the surface are planned for 1984 March.

The Optics: The λ1.2 mm Cassegrain receiver has been mounted and tested. The receiver performed reasonably well, giving a T_{sys} (DSB) of 300 K at 224 GHz (continuum mode). There is presently a problem with the Cassegrain efficiency, not yet identified. Possibilities include the alignment of the flat optics plates, a phasing problem somewhere in the optics, and the figure of the subreflector. Very recent results indicate the problem is the subreflector.

The Receivers: Receivers presently available and checked out are the λ3 mm receiver, λ1.2 mm receiver, and the bolometer. The λ1.2 mm receiver will initially cover the range 200-240 GHz. A mixer covering the range 235-275 GHz is presently on hand at Tucson, but the triplers for the L.O. system are not finished. The 235-275 GHz receiver should be ready by late spring.

The Observing Schedule: The present estimate for beginning astronomical observations is December 15. This date should be considered somewhat soft. There is a backlog of 450 days of observing requests. Those projects which were already scheduled for the period 1983 May-June, but which were not serviced because of the unexpected problems, will be scheduled first. No sunscreen will be available for some time.

The Editor

ANNOUNCEMENT

Mark Gordon will be on leave of absence from NRAO for a period of four months starting February 1, 1984. During this time Dave Heeschen will serve as Acting Site Manager for Tucson operations.

The Editor

The NRAO NEWSLETTER is published bi-monthly by the National Radio Astronomy Observatory, Edgemont Road, Charlottesville, VA. 22903-2475 USA. NRAO is operated by Associated Universities, Inc. under contract with the National Science Foundation.

MILLIMETER-WAVE RECEIVERS FOR INSTALLATION DURING 1984

There are four major receiver upgrades or new receiver systems planned for installation at the 12-meter telescope during 1984.

(i) Extension of the frequency coverage of the 1 mm band receiver from 200-240 GHz to 200-275 GHz, in two bands. This requires the installation of two additional mixers in the multiple mixer receiver dewar and the exchange of the current frequency tripler for a new model which provides more than 2 mW out between 200 and 290 GHz. These components are on hand, and will be installed as the work load in Tucson permits, hopefully early in 1984. Measured receiver temperatures are less than 700 K SSB to 275 GHz, with the minimum being 500 K between 250 and 260 GHz.

(ii) Extension of the above receiver's band to cover 345 GHz. Again the installation of additional mixers in the multiple mixer receiver dewar is required, along with substantial modification to the diplexer L.O. system to accommodate quasi-optical switching between the 200-290 GHz tripler and the 345 GHz multiplier chain. A prototype mixer and a multiplier have been tested, giving a receiver temperature of less than 1000 K SSB at 345 GHz. Installation is expected late in 1984, with the proviso that the surface of the dish be found sufficiently accurate for successful operation at 0.8 mm.

(iii) A new dual-polarized, cooled Schottky diode receiver for 90-120 GHz is currently under construction. The expected receiver noise temperature of this system is about 160 K SSB at 115 GHz. The receiver employs quasi-optical polarization diplexing with L.O. injection via resonant ring couplers. A frequency doubler provides the L.O. signal. Installation of this receiver is expected during the first half of 1984, depending upon Tucson staff load.

(iv) Work is also proceeding on the development of a new dual-polarized SIS mixer receiver for the 100-118 GHz band. A hybrid cryostat is being developed for use in conjunction with the NASA mixer design. Ouasi-optical schemes will be used for polarization diplexing and L.O. coupling. The L.O. signal will be provided by a frequency tripled, YIG-tuned Gunn oscillator. The projected receiver temperature is less than 100 K SSB, with greater than 20 dB image rejection and about 250 MHz useful instantaneous bandwidth at 115 GHz. It is hoped that this receiver will be available late in 1984 or early in 1985.

J. Archer

In General

CALENDAR OF NRAO SPRING 1984 ACTIVITIES

April 11, 12, 13	-	Visiting Committee meets in Charlottesville
May 1, 2	-	Users' Committee meets at Socorro and the VLA site
June 6, 7, 8	-	Green Bank workshop on "The Birth and Evolution of Neutron Stars"
June 20, 21	-	AUI Trustees meet in Charlottesville

R. J. Havlen

USERS' COMMITTEE MEETING OF NOVEMBER 9, 1983

The NRAO Users Committee met in Charlottesville on November 9, 1983. The majority of the meeting involved an extensive review of the operating status of each of the NRAO facilities with an emphasis on instrumentation and programs that are still under development. Since many of these topics have been discussed or will be discussed in the pages of past and future issues of the Newsletter, they will only be itemized at this time.

Topics concerning Tucson activities included a summary by John Findlay and Mark Gordon of the 12-meter resurfacing project. The most recent prime focus aperture efficiency measurements on the new surface give 48% at 3.3 mm and 19% at 1.34 mm. When the telescope becomes available to visiting astronomers sometime in December, three receivers will be in use: the 3 mm coherent receiver, the bolometer (at 1 and 2 mm) and the 1.2 mm mixer receiver (200-240 GHz only). John Archer reviewed plans for 1984 receiver improvements: extension of wavelength coverage of the 1.2 mm receiver to include 200 to 275 GHz, addition of the 320-345 GHz band to the same receiver, construction of a dual polarization Schottky barrier mixer receiver for the 90-120 GHz range, and construction of a dual polarization SIS junction receiver for 100-118 GHz. Sandy Weinreb reviewed potential future receiver developments: SIS junction receivers for other frequencies, multibeaming techniques, 2000 channel-2 GHz hybrid spectrometer, and closed cycle 2-2.5 K refrigerators.

Reporting on Green Bank activities were Rick Fisher, Rich Lacasse and Harry Payne. Agenda topics included: structural analysis and repair of the 300-foot telescope; the USNO interferometer; tests of the new L-band receiver; lateral focusing of the 300-foot and 140-foot telescopes; and the status of work on the 5-26 GHz and the 2-5 GHz receivers. The desirability of having a 7-feed, 5 GHz receiver was also discussed. Plans for the 300-foot spectral processor were described and plans for a new 300-foot control computer were presented.

Issues of immediate interest for VLA users were summarized by Ron Ekers, Carl Bignell, Peter Napier and Don Retallack. The increased number of VLA proposals is forcing the NRAO to advance the VLA proposal submission deadline earlier in time by two weeks (see elsewhere in this Newsletter). Pressure for DEC 10 disk space continues to be high; problems with data integrity have been caused by the use of recertified mag tapes, and absentee observer data editing and calibration have been severely reduced until after the first of the year. Hardware developments at the VLA that were discussed include: interference at 327 MHz and the completion of receiver upgrades and sensitivity improvements at L- and U-band. Potential sensitivity improvements in the 22 to 25 GHz range, possible 44 GHz operation of the array, installation of water vapor radiometers, and the future existence of a second master L.O. were also reviewed.

Sandy Weinreb, reporting on the Central Development Laboratory, explained NRAO's involvement with Cornell in jointly developing HEMT (High Electron Mobility Transistor) devices, which should be superior to GaAs FETs for low noise microwave amplification. Other developments in low noise electronics which may be explored by Sandy's group in the future include: submillimeter receivers in the 300-3000 GHz range, cooled focal plane devices, multiple FET (or other device) receivers for broad bandwidths, and integrated devices for micro refrigeration units.

Bob Burns, head of the Computer Division, outlined the NRAO long term computer plan (see elsewhere), and Ed Fomalont summarized the status of the AIPS post processing program and its implementation at many worldwide institutions.

The current status of the VLBA project was given by Hein Hvatum, project manager. With the 1984 design money approved, work on all phases of the project is proceeding on schedule.

Preliminary site evaluation visits have begun, and the Caltech and MIT groups are advancing the processor and recording system work, respectively. 1984 will also see design of the front-end and feed system as well as electronics for the antenna control system.

The final topic of the meeting was summarized by Sandy Weinreb (for Frazer Owen) concerning the ongoing discussions with the NRAO of a potential millimeter array telescope. These developments will be more fully presented to the external millimeter array advisory committee (Bob Wilson, chair) on January 5 and 6, 1984, at the VLA.

R. J. Havlen

LONG-TERM COMPUTER PLAN

The NRAO is in the process of developing a long-term computer plan which will guide our hardware procurements over the next several years and make recommendations concerning computer management, software, etc.

The plan began with the development of a site plan for each of the Observatory's sites, including Charlottesville. These site plans have been reviewed and further developed by an internal technical group called the Computer Planning Group (CPG). The plan is documented as in a series of memos by this group.

On October 5, 1983, a scientific review of the plan was held by a number of NRAO staff and visiting observers. The purpose of this review was to assess the scientific impact of the recommendations. The computer expenditures will be large, possibly several million dollars, and it is important that the equipment proposed be adequate but not excessive. We are currently awaiting the final report of this group.

Considerable additional technical work will be needed, especially on the larger items and particularly for the VLA and VLBA systems. This work may last six months and will carry the proposals from possible systems to specific recommended purchases, or in some cases detailed requests for proposals. At the conclusion of this phase, the group of computer experts that reviewed the VLA computer activities in early 1982 will be convened to review the detailed technical proposals.

Green Bank

Green Bank plans three main computer projects over the next several years: (1) the replacement of the IBM Remote Job Entry System with a small local computer; (2) the replacement of the 300-foot control system; and (3) the development of the spectral receiver, including computers. Current thinking calls for the use of a 68000 UNIX-based system for each of these projects. The only alternative which appears to be competitive is the use of a small VAX in each case. In the VAX option, the VMS operating system would probably be used. The 68000 UNIX-based solution provides greater vendor independence.

Tucson

The 12-meter control system needs to be upgraded or replaced. The recommended solution is a VAX 11/750 in combination with one of the existing PDP 11's. The plan is to purchase a second identical VAX for use in the Tucson office and for spares. DEC equipment is preferred in this instance because of the existing UNIBUS interfaces.

Charlottesville

This plan involves three projects: (1) the replacement of the AIPS ModComp with a VAX (or VAX-like) system, (2) the development of a 68000, UNIX-based, AIPS system for university support; and (3) the evolution or replacement of the IBM machine. Each of these three projects entails consideration of adopting UNIX as the operating system. On existing VAX's support of VMS would continue.

Socorro

The VLA plan overshadows the others in proposed capital outlay. The plan involves replacing both the on-line (synchronous) system and the current map production system (DEC 10, pipeline, etc.). The plan for a new mapping system is based on work done by two groups. One, led by Ron Ekers, has attempted to estimate the demand for VLA observing over the next several years; the other, led by Bob Duquet, has analyzed computer systems which might meet these astronomical specifications. Time constraints forced the two groups to work essentially in parallel. Current estimates by Ron's group would require a capacity of 75 million floating point operations per second (megaflops). However, most of the effort of Bob's group dealt with systems in the 45 to 60 megaflops range. Since predictions of astronomical requirements are very uncertain, this difference may not be significant. The point is that a system well into the super-computer class costing probably $15 million may be desired. The size of the required system, coupled with budget considerations, led to a request for a plan for a less expensive system (less than $5 million). This plan is currently under development but as yet it is not complete. Most likely, it will be a scaled down version of the least expensive option in the current plan.

VLBA

No specific work has been done on the VLBA plan beyond that described in the VLBA project documentation. It should be noted that current plans for the VLBA system involve the use of four VAX 11/780's (with array processors) running some future version of AIPS.

Additional Information:

CPG Memo # 18 - Summary of Green Bank Hardware Needs - M. Haynes
CPG Memo # 12 - Green Bank Computer Plan 1983-87 - M. Haynes
CPG Memo # 19 - Charlottesville Hardware Plan - R. Burns
CPG Memo # 10 - Graphics Software Support, From Electronics Div. Viewpoint - L. D'Addario
CPG Memo # 9 - Electronics Group Meeting re Computer Planning Group - R. Lacasse
CPG Memo # 14 - A Long Term Computer Plan for Arizona Operations - M. Gordon
CPG Memo # 7 - Upgrade of the VLA On-Line Computer - G. Hunt and K. Sowinski
CPG Memo # 20 - A Computer Plan for the VLA - B. Duquet

R. Burns

SUMMER STUDENT PROGRAM

By now you should have received the formal announcement and applications material for the 1984 summer student program. We would appreciate it if you would bring the program to the attention of interested students. The deadline for receipt of all applications and supporting material is February 1, 1984. Decisions on applicants will be mailed out by March 15.

Jay Lockman

HEALTH INSURANCE FOR FOREIGN VISITORS TO NRAO FACILITIES

The NRAO does not carry medical insurance for costs incurred by Visiting Astronomers who may require medical attention (doctor's consultation, hospital charges, etc.) during their visits to an NRAO facility. Visitors from U.S. institutions are normally covered under group medical plans provided either by their employers or by private insurance plans such as Blue Cross-Blue Shield. It has come to our attention that visitors from some foreign institutions may not have adequate coverage when they are outside their home countries. The skyrocketing cost of medical care in the U.S. makes it highly advisable that all foreign visitors ascertain the applicability of their insurance coverage while they are outside their home countries. Those who find their coverage to be either inadequate or invalid should purchase supplementary coverage for their visit to the U.S.

M. Petty

VLA

PROPOSAL DEADLINES FOR VLA

At present the VLA is scheduled by quarters with a proposal deadline on the 15th of the first month of the preceding quarter. This schedule provides a very short response time to schedule VLA proposals, but the extremely short period (1-2 weeks) between notification and scheduling of observations at the beginning of a quarter places almost impossible pressures on both the VLA scheduling group and the scheduled observers. We propose to lengthen the time between the deadline for proposal submission and the quarter scheduled by moving the deadline one month earlier. We will make this change in two steps: the proposal deadline for the third quarter of 1984 will be advanced by two weeks to April 1, and the deadline for the 4th and subsequent quarters by four weeks. The new proposal deadlines and the configurations in 1984 are as follows:

VLA CONFIGURATIONS 1984

Quarter	Configurations	Proposal Deadline
1984 Q2	C, possibly C/D	January 15, 1984
1984 Q3	C/D, D	April 1, 1984
1984 Q4	D, D/A, A	June 15, 1984
1985 Q1	A, A/B	September 15, 1984

R. D. Ekers

DEC 10 DIAL-IN CAPABILITY

The two dial-in lines will now accept the same modem protocals. These are Bell 103j (300 baud), Bell 212A (1200 baud) and Racal Vadic (1200 baud). The telephone numbers are: 505-772-4346 and 505-772-4362. The use of these dial-in lines is currently restricted to preparing OBSERV files.

Carl Bignell

DEC 10 FILLER PROBLEMS

The real-time FILLER program which transfers data from the on-line computers to the DEC 10 has been losing data during the peak load periods of the DEC 10 due to both the slowness of the DEC 10 and the high data rates (in June 1983 we doubled the continuum data when the B and D IFs were turned on). We have gone into the mode of transferring all data from tape instead of running real-time FILLER because real-time FILLER requires more CPU resources than the tape FILLER and tape FILLER must be run to recover the lost data. As a result there will be a delay of typically four or more hours after the observing program is complete before the data becomes available on the DEC 10.

The other current problem we now have with the DEC 10 is the available disk space. The doubling of the continuum data in June has (especially during A configuration) resulted in putting a premium on disk space and is straining our ability to manage it. For this reason requests for processing old data, particularly large amounts of data, may have to be postponed a few months. Early in 1984 we will alleviate both the disk space and overworked DEC 10 problems by using the pipeline to process the bulk of the data.

Carl Bignell

UPDATE ON TRAVEL SUPPORT FOR VLA DATA REDUCTION

The NRAO continues to provide limited reimbursement of travel expenses for VLA observers who use NRAO facilities to reduce VLA data. Complete guidelines for the program were given in NRAO Newsletter No. 2 (September 1, 1981). Two reminders, however, are appropriate at this time:

- Participating scientists are strongly recommended to contact Ed Fomalont (VLA: 505-772-4247) well in advance of their intended visit in order to assure that the proper time and resources are available. Excessive demand on the AIPS facilities at the VLA or in Charlottesville can be avoided with proper scheduling. Advance consultation with Ed may save valuable time and allow you to avoid subtle data reduction pitfalls.

- Although the initial visit to an NRAO facility for a given project could be either for observing or for data processing (in the case of remote or absentee observing), it must incur the $150 minimum deductible. When a visit includes activities for more than one project, the deductible will be calculated on the basis of the project which results in the largest deductible.

R. J. Havlen

Green Bank

300-FOOT CONTROL COMPUTER UPGRADE

The replacement of the DDP-116 300-foot control computer with a Mass-Comp MC-500 is just getting underway. For the next six months or so, we will be designing the user interface portion of the software, and we are compiling an observer's wish list of features to be included in the system. Your comments and suggestions will be very much appreciated.

We would like the new system to be as easy as possible to use by new observers without heavy reliance on manuals. What do you think are the most natural and self-evident display and input formats? Would a lot of graphics help? What can our present computers not do that you would like to see implemented on the new system? On what medium would you like to bring observing schedules to the telescope? Do you know of an existing system whose features you particularly like?

We received responses to some of these questions in a questionnaire sent out by Mark Damashek. If you did not receive a questionnare or you have additional comments, please contact Harry Payne or me.

Rick Fisher

1.3-1.8 GHz COOLED FET RECEIVER: MORE NEWS

The 1.3-1.8 GHz cooled FET receiver has been completed and tested. Observations on the 140-foot in August at 18 cm (see previous Newsletter) and in September at 21 cm showed that the system temperature at zenith was 23 K to 25 K over both the 1360-1430 MHz and the 1610-1720 MHz bands. Aperture efficiency varied from about 58% at the middle of these bands to about 54% at the band edges. A brief description of the receiver configuration and capabilities follows:

Three hybrid-mode feeds have been designed for use with the receiver:

1. 1300-1365 MHz
2. 1360-1430 MHz
3. 1610-1720 MHz

Feeds 2 and 3 have been constructed and tested, and feed 1 should be ready for use in the first quarter of 1984. All of the feeds interchangably connect to the dewar waveguide input, 16.3 cm diameter circular guide. Feed changes will take 1-3 hours, depending on weather, etc., and taking longer on the 300-foot than the 140-foot. Inside the dewar, cooled to 15 K, are an orthomode transition, stripline cal couplers, and three-stage FET amplifiers.

Outputs of the OMT are linear, orthogonal polarizations. Provision is made to switch to circular polarization by combining the linear channels in a stripline hybrid. There is no penalty in system temperature since approximately 60 dB of gain precedes the hybrid. Users wishing to observe with circular polarization should so indicate in their observing requests, as it is helpful to do some laboratory polarization measurements prior to installing the receiver.

Following the polarizer is a group of remotely selected bandpass filters. The filter passbands roughly coincide with the feed bands and are intended to keep interfering signals from entering the mixer.

It is possible to use a separate local oscillator for each receiver channel, but for normal observing a single ULO drives both channels. Care should be taken to keep the L.O. signal out of the 1250-1850 MHz frequency range. This requires using the lower sideband for 18 cm observations and a first IF of 250 MHz or greater.

Roger D. Norrod

SPECTRAL LINE TESTS WITH THE L-BAND RECEIVER AT 21 CM

During September I observed the HI and H166α (1425 MHz) lines with the 1.3-1.8 GHz cooled FET receiver to test its performance. Many of the observations duplicated ones made during August with the old cooled FET receiver so that differences between the two systems could be determined. The HI measurements were frequency-switched with a bandwidth of 2.5 MHz; the recombination line measurements were taken total power with a bandwidth of 5 MHz.

System Temperature: My measurements agree with those reported by R. Norrod above. A typical observation at 1425 MHz of the galactic plane at longitude 90° and elevation 33° gave a system temperature of 27 K, some of which comes from the plane itself. Galactic HI observers should note that the HI line will contribute a noticable amount to the system temperature of this receiver at a 2.5 MHz bandwidth even when observations are made some distance from the galactic plane.

Aperture Efficiency: This was not measured directly, but an increase over previous systems is noticable in the form of stronger antenna temperatures for recombination lines from resolved sources.

Main Beam Efficiency: This is less certain, but observation of standard HI regions as well as areas of extended recombination line emission suggest that the main beam efficiency of this receiver is increased by perhaps 0.07 over our old scalar-feed systems. Also, high latitude galactic HI spectra taken with the new receiver show less emission than those taken with the old receiver one month previously at an identical position and LST, calibrated identically. This is consistent with a higher main beam efficiency for the new receiver, resulting in smaller far sidelobes and thus a smaller stray radiation component in the spectra.

Baselines: The new receiver is comparable to or better than previous L-band systems. Continuum intensity seems to be the dominant determinant of baseline behavior. When the continuum temperature is less than 5 K, baselines showed slopes ~0.01 K/MHz with little curvature after a pair of defocussed on-off scans were averaged. Baseline slope and curvature increase with the source continuum temperature; at T_c = 32 K the slope was ~0.1 K/MHz. Observations at very low elevation may also give more slope and curvature. The baselines from front end B are better than those from front end A, but averaging spectra from the two receivers gives better baselines than either individually. The baselines for frequency-switched constant-focus HI spectra are smooth and well-described by a 2nd order polynominal over 2.5 MHz.

Stability: It is excellent. The above comments on baselines refer mainly to 1425 MHz on-off pairs where the "on" was taken up to an hour after the "off". It seems likely that for total power surveys "off" spectra need to be taken only a few times a day unless elevation changes are extreme, there is strong source continuum, or the lines are very broad. There was no indication of spurious spectral features at a level $\lesssim$0.01 K.

A report giving a more complete description of the overall system properties will be available from H. Payne in Green Bank early in 1984.

Jay Lockman

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