NRAO NEWSLETTER

1985 March 1 No. 22

VLBA

THE STATUS OF THE VLBA

General

Since the last note on the status of the VLBA in the 1984 September 1 issue, there have been several budget "scenarios" postulated by the NSF, along with requests for the overall effect of each on the Project. The most recent, which was submitted formally at NSF request, called for a reduction, in 1986, from the earlier $16-million figure to $11.5 million, with resumption of the higher levels in the later years of the Project. This change will cause significant delays in portions of the Project other than antenna construction, and places completion of the VLBA well into 1990. It should be said, however, that this change is less severe than some of the alternatives the Project Office was asked to study!

A design review and workshop involving leaders of the various groups responsible for segments of the VLBA system was held in Socorro 1985 January 22-24. A number of design decisions were finalized and many still-outstanding issues were clarified.

Stations and Antennas

Proposals for the design, manufacture, and installation of the ten VLBA antennas were carefully evaluated. The ESSCO proposal, which included radomes for all antennas, proved too expensive, and was eliminated on this basis. It was determined that either Radiation Systems, Inc. (RSI) or TIW Systems, Inc. (TIW) was capable of providing an antenna to NRAO specs. Moreover, each was able to propose surface panels with a deviation from design surface of 0.127 mm (0.005") rms within a total price that did not exceed our anticipated antenna budget. Pre-contract negotiations were held at the plant of each of the two firms. RSI was selected, primarily on a price basis.

The schedule calls for completing installation of the first antenna on the Pie Town, New Mexico site in December, 1986, with the remaining nine installations to be completed at roughly 4-month intervals thereafter. Station construction schedules will be phased such that site access, utilities, foundations, etc. are available as required for the antennas. Unfortunately, delays in other subsystems due to budgetary constraints may preclude full instrumentation of the earlier antennas until later in the program. Slowdowns in the antenna and Station construction schedules have been considered as a means of avoiding such a situation, but this increases costs significantly.

The present budget plan cannot provide construction funds for the Array Operations Center until 1987. Temporary space may have to be found for a central control facility for early tests of the partially completed Array.

The architect/engineer (A/E) firm of Stevens, Mallory, Pearl and Campbell of Albuquerque was selected, and a contract with them is awaiting NSF approval at this writing. They will soon undertake the design of the building and other facilities for the Pie Town Station.

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Electronics

RFI measurements at Pie Town, Kitt Peak, and Los Alamos were completed, and all appear acceptable. All prospective sites will be so evaluated.

It was decided that masers, in the numbers required, would require too much maintenance to permit their use in front ends at 23 and 43 GHz. Development is concentrating on the HEMT for use at 23 GHz and the SIS junction for 43 GHz.

The 8.4 GHz front-end prototype, now complete, is in a sense the prototype for the front ends at 4.8 and 15 GHz as well. All will use the CTI Model 22 refrigerator and similar dewars. Tests show that it will be best to use the larger Model 350 with the L-band front end, however.

Development work on components of the common LO system is centered at Green Bank, while that on frequency converter modules is in progress in the Central Electronics Lab.

Data Recording

The longitudinal recording system has been chosen over one based upon multiple video cassette recorders. A recording density of over 10 megabits per square inch has been demonstrated in actual VLBI operations, and tests with still narrower track widths and thinner tape are promising. It seems certain that continuous recording at 100 Mb/s for 12 hours will be possible using a single tape.

As a result of design consultations between NRAO and the subcontractor, Haystack Observatory, there have been some changes from the originally proposed, modified Mk III recording format in the interest of minimizing losses in system sensitivity and improving reliability.

Monitoring and Control

Where possible, computer hardware will be similar in the various subsystems. The Array M/C Computer and the Correlator Control Computer will both be DEC VAX machines using VMS operating system, while the Station Computers and the Correlator fringe processors will probably be based on the new Motorola 68020 processor.

Correlator

The Correlator subcontract with Caltech was signed in 1984 September. Work has concentrated thus far on architectural design and on a possible custom correlator chip. An alternative to such a chip may be a chip developed for the Australia telescope. It may offer cost savings if it will support the application.

Paul Sebring

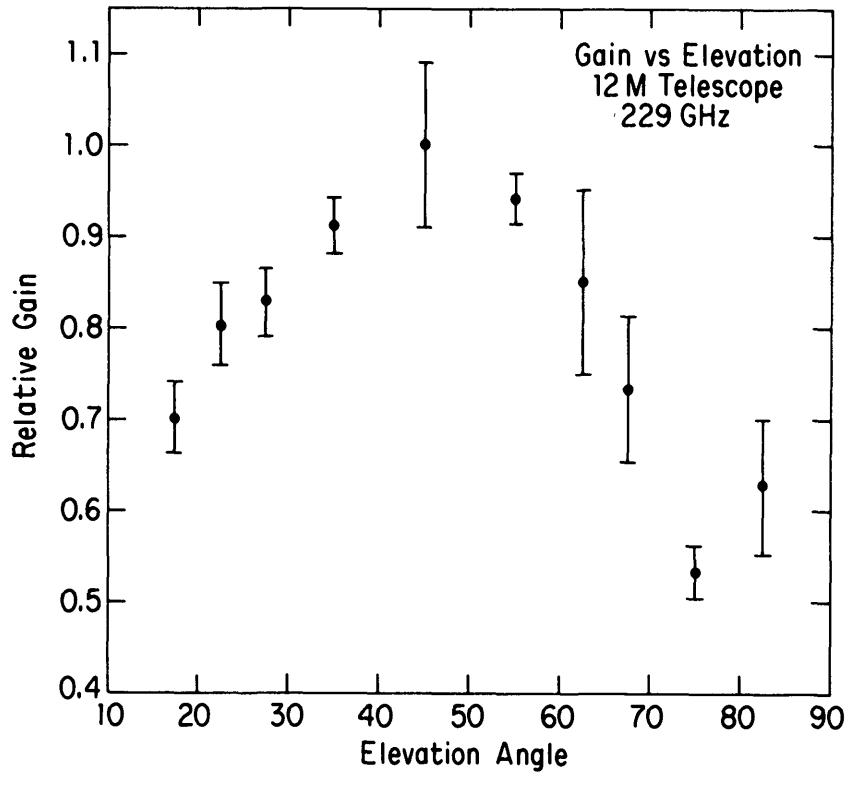
12-Meter

λ1.3 mm CASSEGRAIN EFFICIENCIES WITH THE COHERENT RECEIVER

Several Cassegrain efficiency factors have been measured that are important for spectral line and continuum observations at λ1.3 mm with the cooled, coherent receiver:

Aperture eff. $\eta_A = 0.20 \pm 0.02$
Rear spillover and scattering eff. $\eta_\ell = 0.85 \pm 0.05$
Forward spillover and scattering eff. $\eta_{fss} = 0.75 \pm 0.05$.

Preliminary measurements indicate that within a solid angle the size of the moon's, ~ 47% of the antenna power is in the main diffraction lobe and ~ 53% of the power is in the error pattern and sidelobes. Continuum sensitivity is 8-9 Jy/s, excluding the atmosphere, in each channel and 6-7 Jy/s with the two channels averaged. The gain of the telescope varies significantly with elevation at this wavelength. A gain-elevation curve, measured with small angular diameter sources, is shown below. All of the above measurements will be repeated to reduce the uncertainties. A complete report of telescope properties as presently understood is being prepared for the "12 m Memo Series."



P. R. Jewell, J. M. Payne, and C. J. Salter

BOLOMETER TESTS AT λ1.3 mm

The ^{3}He bolometer, equipped with a new element, was tested in the λ1.3 mm region during a four-day session in January. The results were generally positive. The sensitivity of the device was measured to be 2-6 Jy/s, excluding the atmosphere, which is better than the sensitivity of the coherent receiver operating at the same frequency. System noise with the device is a very sensitive function of atmospheric conditions, and was found to be correlated with the magnitude of the subreflector beam throw. The FWHM of the beam was ~ 36", which is slightly larger than theoretically predicted. The beam shape is Gaussian.

Bandpass filters for the 2.0 and 1.3 mm wavelength regions are available for use with the bolometer. The half-power bandpasses of the λ2.0 and 1.3 mm filters are 35 GHz and 66 GHz, respectively. The mean "hold time" of the ^{3}He dewar is ~ 48 hours. About 2 hours are needed to recycle the ^{3}He. In addition, a few minutes are required daily to replenish the liquid nitrogen in the dewar jacket. A computer controlled, synchronous chopper wheel covered with absorber is available for calibration and sky tipping scans.

P. R. Jewell, J. M. Payne, and C. J. Salter

VLA

AIPS - DICOMED FACILITIES AT THE VLA SITE

At the VLA site exact copies of the IIS screen can be transferred directly and fairly smoothly to 35 mm film. The 35 mm frames may contain a single screen image or a mosaic of up to six screen images; text captions may be added in a variety of colors and character sizes. The first step is to get the image that one wants recorded to look the way one wants it on the VAX IIS screen (in AIPS), then use the verb T3VERB (with an appropriate OUTNAME) to record the screen onto a set of intermediate disk files. When one has thus saved all the images one wants recorded, exit from AIPS and type (at VMS level): DICOMED. This logs the user into the PDP-11/44 DISPLY (to which the DICOMED recorder is attached) and sets a recording request program running. In dialogue style the user may then specify all the 35 mm frames he wants recorded. After reviewing a summary the user may delete or save the recording request and will be logged out and returned to the VAX. Recording requests are saved in request files with a user specified name (preferably the user's name) and will be picked up by the evening computer operator who will take care of the recording automatically unless the request file name starts with an "X." Recording is done by reading the intermediate disk files over DECNET. Processed film will be mailed to the requesters. This procedure works from both VLA VAXes and could in principle also be used from the Charlottesville and Tucson VAXes. There are also provisions to record larger images (up to 4096), but this process is rather involved.

Arnold Rots

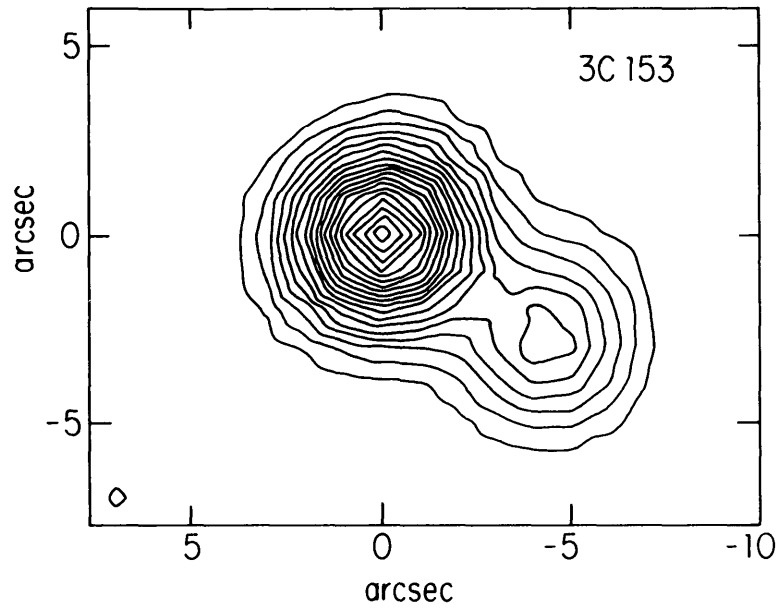
VLA "GREEN BOOK"

Between April and September 1985 most of the chapters in the "Green Book", "An Introduction to the NRAO VLA," will be updated or re-written. Anyone with suggestions, known errors, etc., should send them to one of us, in writing.

Bob Hjellming and Pat Crane

FIRST VLA MAP AT 327 MHz (CORRECTION)

The map presented in the last issue of the NRAO Newsletter as the first VLA map at 327 MHz was not correct. The correct map was of 3C 153 and is presented here.



First VLA map of a non-calibrator source at 327 MHz

The map shows the distant radio galaxy 3C 153 at 327 MHz with 3.5 arcsecond resolution. It is centered at RA $06^h05^m44^s.438$, DEC $48°04'48''.80$. Peak flux is 6.145 Jy/beam. The data were taken using 4 antennas on November 23-24, 1984, from approximately 10:30 p.m. to 3:30 a.m. The phase stability was terrible, so no phase calibration was possible. The data were resurrected by using self-calibration with an initial point source model. After 4 iterations, the above map, with better than 15:1 dynamic range, was produced.

The map is in excellent agreement with the Cambridge 5 GHz map, except that the flux ratio between components changes from approximately 1:1 at 5 GHz to 3:1 at 327 MHz.

Carl Bignell

PROGRESS ON LOW FREQUENCY DEVELOPMENT

327 MHz

There are currently five antennas outfitted for 327 MHz observations. A sixth is expected early in April. Durga Bagri has made modifications to the L7 (fringe generator) and L8 (digital divider) modules for interference suppression. Bench tests are very encouraging, both at this frequency, and at 75 MHz. These test modules have been inserted into antenna 15 for astronomical testing.

75 MHz

At 75 MHz, we are installing two different feed systems for the purpose of testing whether the 25-meter antennas can be used at this frequency. A simple crossed dipole feed is to be placed on antenna 20, and a double-dipole (boxing ring) system is to be on antenna 21. Testing of these arrangements will be done during the next two months.

Rick Perley

PRIORITIES FOR AIPS DEVELOPMENT

Both AIPS and the "Wishlist" of desirable changes to, or augmentations of, the AIPS package have become very large. The current AIPS "Wishlist" (AIPS Memo. 34) will soon be available on request from Nancy Weiner in Charlottesville. Manpower limitations are such that many items on this "Wishlist" may have to be deferred for several years. We have, therefore, begun an observatory-wide discussion of scientific priorities for the development of AIPS. There are monthly telephone meetings between the various NRAO sites to discuss AIPS Priorities, and users are welcome to participate in any of these meetings which take place while they are visiting one of the sites. There is also an ongoing Vaxmail "conference" in which contributions from non-NRAO AIPS users would be welcomed. The arrangements for this conference are described below.

The Vaxmail discussion is organized into the following six topics.

A. TASKS

What features of existing AIPS tasks (and verbs!) most limit synthesis data reduction now, and, therefore, deserve high priority attention? (e.g., MX? ASCAL? UVSUB? Others?)

B. SYSTEM

What features of the existing AIPS system most limit synthesis data reduction now, and therefore, deserve high priority attention? (e.g., Problems with Batch? Catalog Structure? Inefficiency of big backups? Other things?)

C. NEW SOFTWARE

What new software is most urgently needed within AIPS? (VLA spectral line applications? VLA continuum applications? Calibration (VLBA interface)? Single dish applications? Full AIPS-in-a-supercomputer? Other?)

D. DOCUMENTATION

What documentation improvements are most likely to lead to better informed AIPS use? (A new Cookbook? A "Help/Explain Manual?")

E. DEBUGGING

How might we improve debugging of new AIPS releases?

F. WISHLIST

Are there important items missing from the AIPS Wishlist (AIPS Memo 34)? Do you want to see any item(s) substantially upgraded/downgraded in priority in the AIPS Wishlist? (Which, and why?)

AIPS users are welcome to contribute to the Vaxmail conference by writing to Alan Bridle in Charlottesville or, at any time that they have access to the NRAO DecNet system, by Vaxmail to CVAX::BRIDLE. Each contribution will be categorized to one or more of the topic areas, e.g., AIPS Priorities - Tasks, AIPS Priorities - New Software, etc., and will then be forwarded by Vaxmail to dedicated logins called AIPSPRIO on the Charlottesville VAX (CVAX) and VAX3 at the VLA.

To read the conference contributions to date, log in to CVAX or VAX3 as AIPSPRIO. No password is required. You will get a MAIL> prompt from the VAX MAIL utility. Type:

dir task	to review the authors/dates of the mail on	TASKS
dir syst		SYSTEM
dir news		NEW SOFTWARE
dir docu		DOCUMENTATION
dir debug		DEBUGGING
dir wish		WISHLIST

To read individual contributions using the READ command in MAIL. (Type HELP for text documenting the VAX MAIL utility.) Visitors to Charlottesville or to the VLA can take up-to-date hard copy of the conference contributions--consult Alan Bridle in Charlottesville or Pat Moore at the VLA for assistance. Printouts of the conference will also be available by (regular) mail on request to Alan Bridle in Charlottesville.

Alan Bridle

VLA VISITOR CENTER ACTIVITY - 1984

Bad weather in December dropped our visitor count, and we ended 1984 at approximately 9648 visitors. We had four months, May, June, July and August with over 1000 visitors a month. Brochure and postcard sales have been good, and the Recreation Association has sold several hundred VLA shirts and jackets by mail order.

The visitor center slide show was operated 3555 times in 1984. This represents about 750 hours and 480 thousand slide changes without any slide equipment failure.

D. Swann

Green Bank

COOLED FET S-BAND RECEIVER

A dual-amplifier, cooled FET receiver has been constructed for S-band by Richard Bradley, Roger Norrod, Carl Chestnut, and others. It is very similar to the L-band receiver in use for more than a year. Over the range 2.9-3.4 GHz, pure receiver temperatures for both channels vary between 15 and 25 degrees Kelvin, depending upon the frequency; 17 K is a reasonable mean figure. The sky should contribute an additional 5 degrees Kelvin and ground pickup almost as much. Calibration signals have been measured at intervals of 10 MHz between 2.9 and 3.4 GHz. These run between 1.5 and 2.0 K, again depending upon frequency. System temperatures on the telescope should, therefore, be < 30 K.

Two feeds presently exist; one for the approximate range 3.0-3.2 GHz, and the other for 3.2-3.4 GHz. (The cutoffs at each end are not abrupt.) Each is a scaled version of the successful L-band feed, featuring low spillover and high main-beam efficiency. The feeds link to the amplifiers through cooled orthomode transitions. Feeds for other frequencies in the approximate range 2.0-3.5 GHz can be constructed, but require at least three months lead time. Each will have a passband of about ten percent of its central response frequency.

System tests are scheduled on both the 300-foot and 140-foot telescopes before the end of May 1985. If successful, proposals for use of this receiver will be accepted.

George A. Seielstad

CHANGES TO THE L-BAND RECEIVER

In response to requests by members of the observing community, we have made two changes in the 1.3-1.8 GHz receiver. First, the noise calibration level has been decreased from 2-4 Kelvin to 1-2 Kelvin. Second, a solid-state transfer switch has been installed so that polarization switching experiments can now be performed. The switch is located following the RF amplifiers and the circular polarizer so that there is no noise temperature penalty.

Roger D. Norrod

FILE TRANSFERS BETWEEN CHARLOTTESVILLE AND GREEN BANK COMPUTERS

Files can be transferred in either direction between the VAX computer in Charlottesville (so called, CVAX) and the MASSCOMP computer in Green Bank. The transfer occurs through an intermediate personal computer, using TELIOS/Kermit in an IBM PC or Macterminal in a Macintosh.

This facility is expected to be especially important to the VLBI community using the 140-foot telescope in Green Bank because schedules can be read into CVAX using DECNET. Thereafter they can be transferred to Green Bank, where the MASSCOMP can write a tape readable by the 140-foot's Modcomp control computer. Personnel in Green Bank can also read VAX mail.

George A. Seielstad

In General

UPCOMING OPEN DISCUSSIONS OF THE MILLIMETER ARRAY PROJECT

During 1985 we want to concentrate on combining our work with the detailed science that the astronomical community can foresee. We are working on several ways to accomplish this goal. First, we are in the process of appointing a scientific advisory committee. Jack Welch will chair this group. Second, we are going to hold two open meetings of one day each during which we will present our current ideas and discuss them with the community. The first meeting will be on Thursday afternoon May 9, 1985, and Friday morning May 10 at the University of Arizona in Tucson. This meeting will be just after the NRAO Users meeting in Tucson. The second meeting will be Monday, June 3, 1985 in Charlottesville, Virginia, 9 a.m. - 5 p.m. This meeting will be the day before the Charlottesville AAS meeting and will be held in the NRAO auditorium on Edgemont Road.

Those who are interested in the project are encouraged to attend at least one of the meetings.

F. Owen

UPDATE ON STAFF VISITORS AND LEAVES

The following scientists, visiting the NRAO for more than three months, have not been previously announced in the Newsletter:

Gerrit Verschuur is visiting Charlottesville from Boulder, CO; Tom Bania is visiting Charlottesville from Boston University; and May Kassim is visiting Green Bank from Iraq.

In addition, the following NRAO scientists are on temporary leave at other locations:

Ed Fomalont is at Nobeyama Observatory assisting with the installation of AIPS and the new millimeter interferometer. Dave Heeschen was awarded a Humboldt fellowship to visit the Max-Planck Institute in Germany.

R. J. Havlen

INTERNATIONAL HALLEY WATCH PROPOSAL DEADLINE

The NRAO is now beginning to receive proposals to observe Halley's Comet. Over 50 days between the end of August, 1985, and July, 1986, have been targeted by International Halley Watch (IHW) for radio science experiments, and the NRAO has agreed to give priority to Halley proposals during those dates. We anticipate receiving several proposals for continuum and spectral line studies using the 140-foot, 12-meter, and VLA telescopes as well as several time-specific proposals for multiwavelength coordinated programs.

In order to allow sufficient time for proposal review and other logistic arrangements, the NRAO requests that all Halley Comet proposals be submitted to the Director's office before July 1, 1985. All proposals received prior to that date will be similarly evaluated for scientific and technical merit before the final commitment of observing time is made. Although the NRAO will make every reasonable effort to accommodate last minute meritorius requests to observe Halley's Comet, this will become increasingly difficult once the schedules start to fill up. Your cooperation in meeting the above deadline will be appreciated.

R. J. Havlen

CHARGES FOR NRAO DATA TAPES

The increasing volume of magnetic tape usage at the NRAO is continuing to trend upward. At the VLA alone, tape expenditures have risen from $37 K to $48 K since 1983. It has therefore become necessary to institute a charge for all magnetic tapes supplied to NRAO users, effective April 1, 1985, as follows:

1. $11 per tape for those carried away by the user. At the sites this charge will be added to the room invoice.

2. $13 per data or archive tape shipped by NRAO. This fee covers shipping by surface the least expensive way. The cost of shipping outside the continental U.S. or other non-standard means of user-requested shipment will be added to the $13 fee and invoiced to the user.

3. At the VLA, NRAO will furnish tapes to be used for data storage in the tape vaults at no charge.

4. Users may bring their own tapes for data storage, provided these tapes meet NRAO standards.

MILLISECOND PULSAR WORKSHOP PROCEEDINGS

The Proceedings of the Green Bank Workshop on Millisecond Pulsars is now available for general distribution. Copies can be obtained from Berdeen O'Brien, Green Bank, free of charge.

Formally entitled "Birth and Evolution of Neutron Stars: Issues Raised by Millisecond Pulsars;" eds. S. P. Reynolds and D. R. Stinebring, this volume follows from the NRAO workshop held in June 1984. The workshop was attended by 56 astronomers from the U.S., Great Britain, the Netherlands, Italy, India, and Australia. No new millisecond pulsars were reported at the meeting, but there was much discussion of the origin of millisecond pulsars, their observational properties, the physics of rapidly rotating stars, and reports of ongoing searches for more millisecond pulsars.

The Proceedings includes 44 papers, transcriptions of the discussion which followed the presentations, and summary remarks by V. Radhakrishnan. It is soft-bound and runs 350 pages.

D. R. Stinebring

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