NRAO NEWSLETTER

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Special Item

ANNOUNCEMENT

Proposals from NRAO for two major telescopes are before the National Science Foundation: the 25-meter millimeter-wave telescope and the Very Long Baseline Array (VLBA). Both projects have been extensively discussed within the astronomical community, the NRAO, and the NSF. Both instruments represent important steps in the future growth and development of astronomy. Both should be built. However, even in sounder financial times, it is unlikely that both would be funded concurrently. Thus, we have been asked by the NSF to choose one of these projects as our first priority for construction in FY 1985 and beyond. Let me first briefly review these projects.

Elsewhere in this Newsletter there is an item on the submission of a VLBA proposal to the NSF. This project goes back more than half a decade, to the first major report on a dedicated array, entitled "An Intercontinental Very Long Baseline Array," that was issued by the NRAO (May 1977). Discussion about such a project has been widespread for some time. The breadth of support and interest in a VLBA is marked by its first priority status for major new ground-based facilities in the 1982 report of the Astronomy Survey Committee (the Field Report). NRAO submitted a proposal for the VLBA because of its scientific merit and need and because of our responsibilities to the radio and to the entire astronomy community.

The history of the 25-meter can be traced to an earlier (1972) report of the Astronomy Survey Committee (the Greenstein Report), which recommended construction of a large millimeter-wave antenna. A proposal for such an instrument, the 25-meter, was submitted to the NSF in September 1975 and an update in July 1977. The estimated cost in 1976 dollars is $12.5 million, an amount equivalent to the currently requested $34.8 million for funding of construction in the two-year period 1984-85. This increase is almost wholly due to inflation.

Funds for the 25-meter telescope were specifically requested in the budgets submitted by the President to the Congress for FY 1981 and 1982, clearly a sign of strong support within the NSF and the appropriate executive offices involved in preparing these budgets. Unfortunately, the 25-meter was removed from each of these Presidential budgets for reasons unrelated to its scientific value. It is worth noting the language used to describe the removal of this project from the current (FY 1982) budget. Quoting from page 227 of House Document No. 97-21, entitled "Message from the President of the United States Transmitting a Plan to Achieve Recovery for the Nation's Economy", "The President plans to selectively reduce or eliminate some National Science Foundation programs... All new programs proposed in the 1982 budget, such as university laboratory modernization grants and the 25-meter telescope, would be deferred for future consideration." This fiscal blow is still with us. The 25-meter is not in the FY 1983 budget now before the Congress. The current prognosis is that there is little likelihood of major construction monies in the 1984 budget.

These delays in funding generated increasing concern in some quarters of the astronomical community. The first change in the high priority given the 25-meter was recorded in April of this year by the Astronomy Advisory Committee of the NSF. (This same committee expressed a similar view in a telephone poll held on November 23, 1981.) The

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previous broad support, both within and without the NSF, has lessened. The reasons for this change are less germain than the fact that support is less. In the current climate of tight fiscal policies and major competitive projects, it is inopportune to continue with the 25-meter as our highest priority project for FY 1985 and beyond.

It is urgent that the astronomical community, in conjunction with the NSF, proceed with major new instrumentation. We are therefore identifying VLBA as our primary construction effort for FY 1985, with the hope and expectation of initial monies in 1984 for detailed design.

NRAO intends to continue its role of supporting millimeter-wave astronomy and the research and development of new equipment. The upgrading of the 36-foot to a 12-meter telescope with a more accurate surface is one step. We, both internally and together with the community, in meetings to be held later this year, will search for new initiatives to ensure that millimeter-wave astronomy remains a viable and exciting area of astronomical research.

M. S. Roberts

VLBI

MILLIMETER-WAVE VLBI EXPERIMENT

In May 1982 a VLBI experiment at millimeter wavelengths was conducted between five stations: Hat Creek, Owens Valley, NRAO Kitt Peak, UMASS Quabbin, and Onsala. The objective was to observe extragalactic radio sources at 89 GHz (3.4 mm)--a wavelength at which the 3-mm window is most transparent. To determine the baselines, the observations began at 6 cm (the lowest frequency ever used at the 36-foot telescope).

Fringes have been obtained, so far, between Kitt Peak and Owens Valley and between Kitt Peak and Hat Creek, for the sources 3C 84 and 3C 345. The projected baseline for the latter is about 1000 km, which corresponds to 0.3×10^9 wavelengths or 0.0006 arc seconds. This resolution corresponds to a 4-foot beach ball on the Moon, or the diameter of a quarter seen from 4000 miles. This baseline in wavelengths is close to the longest ever used (1.3 cm, NRL to Parkes). To achieve this angular resolution optically, one would need a 150-m (6000-in) telescope above the atmosphere.

The results may get better. A preliminary processing of the Owens Valley-Quabbin tapes showed a possible fringe at 6 sigma. While this could turn out to be only a glitch, it raises hopes for the much higher quality data of the Kitt Peak-Quabbin baseline, yet to be processed.

The NRAO equipment had not been designed for VLBI work, but within a couple of weeks we were able to build a suitable LO and modify our 3-mm cooled receiver. Within a couple of days, we were able to build a 6-cm cooled receiver with a receiver temperature of 70 K.

We anticipate more work of this kind. The scientific interest is not just higher angular resolution, but observations at mm-wavelengths should give important new information about the cores of energetic events in quasars.

Mark Gordon

VLBA PROPOSAL SUBMITTED TO NSF

On May 14, 1982, the NRAO submitted a proposal to the National Science Foundation requesting financial support for the construction of a Very Long Baseline Array (VLBA). The Astronomy Survey Committee ranked VLBA as the highest priority for major new ground-based instrumentation. This project has been well received within the Foundation, and there is some hope that initial funding for detailed design work may start as early as fiscal 1984.

Ken Kellermann has been named Program Manager. Together with Hein Hvatum, Associate Director for Technical Services, he is coordinating the design effort within NRAO and by members of the VLBI community.

M. S. Roberts

NEW VLBI FRINGE FITTING CAPABILITIES

We currently have two improved fringe fitting capabilities. The first allows determining antenna-based delays and rates from the output of a free fringe fit and using these results to constrain a subsequent fringe fit. This process has the advantage that it forces delay and rate closure and allows the use of baselines for which fringes are too weak to be detected.

The second process is a self-calibration-like program which solves for antenna-based delays and rates using all available information, including, if desired, the effects on baseline delay and rate of source structure as determined from the current model. Solutions for one data set can be applied to another, allowing calibration for weak sources. Polarization data is processed by fitting IF-based delays and rates and then applying the results to both parallel and cross polarization correlations. This process should greatly reduce the sensitivity requirements for polarization VLBI.

These procedures allow work on much weaker sources since the sensitivity of the entire array can be employed. The software for these functions is available as a part of the AIPS image processing system.

Bill Cotton

Green Bank

CAMPAIGN TO INVESTIGATE THE 140-FOOT PERFORMANCE AT HIGH FREQUENCIES

During the summer, several blocks of telescope time are being devoted to pointing, calibration and tests of the 140-foot telescope at short wavelengths, especially 1.3 cm. Observers desiring up-to-date information on the status of the 140-foot should contact Harry Payne before the winter 1.3 cm observing period.

Martha Haynes

IMPROVEMENTS TO THE 6/25 CM-RECEIVER

The 6/25-cm receiver upgrade was completed in April 1982. NRAO cooled GASFET amplifiers were installed to replace the original 25-cm upconverters. The result is a more stable receiver with 25-cm system temperatures of 35-40 K over the frequency range of 1000 to 1500 MHz.

J. Coe

GREEN BANK ASSEMBLY OF THE 12-METER TELESCOPE

For the last few months, the Green Bank warehouse has been the site of great activity as the scene of major work on the new 12-meter surface for Tucson. In preparation for the arrival of the backup structure and panels, the warehouse was emptied and numerous modifications were made to allow John Findlay and a host of Green Bank employees to test out the antenna surface setting and measuring scheme. Armed with an Apple computer, Findlay will set the surface by matching sensors attached to a template fabricated in the Green Bank shop which in turn can be compared to a precisely-defined surface (reference jig). The combined efforts of telescope mechanics, shop personnel, engineers, and whoever else could be pressed into service got the backup structure assembled rapidly. While the structure was going up, next door in the shop, the machines were fabricating the necessary additional components. Enough surface panels were then installed to allow finalization of the panel mating to the structure and check-out of the setting procedure.

At press time, work in Green Bank is winding down. The panels are on their way to Tucson and shortly the backup structure will be disassembled, the location of each piece being carefully noted to ease the reassembly, under more difficult conditions, on Kitt Peak. Delivery of the structure is expected in Tucson in a few weeks. After these months of long, arduous work on the 12-meter project, Green Bank looks forward to filling up its warehouse again.

Martha Haynes

140-FOOT DECLINATION ERROR

An error has existed for 18 months in the computation of the declination pointing correction in the H316 computer. The error occurred in calculating the term sin D cos H - tan L cos D; when the result was less than 0.99999 in binary equivalent, the significant binary bit was lost. This resulted in a declination pointing error for declinations south of -13° 07' 30". The pointing error was about +70" (Cassegrain) or +100" (prime focus) at the meridian, and decreased with increasing hour angles such that for hour angles larger than $3^h\ 15^m$ east or west the pointing error was zero. As seen by the observer, the pointing corrections to be added would have been -70" and -100" at the meridian. The problem was corrected in the H316 code on 21 June 1982 and the pointing was checked.

Bob Vance

REQUEST FOR SOURCE LISTS IN PROPOSALS

In order to avoid conflicts between overlapping proposals, proposers should include a source list including coordinates with proposals for the 300-foot and 140-foot telescopes. In the case of large source lists (> 50 objects), a precise definition of the observing sample may be substituted. Please list sources by their most commonly referenced names.

Martha Haynes

GREEN BANK WORKSHOP ON LOW-FREQUENCY VARIABILITY

A workshop on "Low Frequency Variability of Extragalactic Radio Sources" was held in Green Bank on April 21 and 22, 1982. Approximately 35 scientists from the U.S. and abroad discussed radio source variability at frequencies below 1000 MHz. It was an excellent opportunity to sift through observational results and discuss the viability of theories of the phenomenon. Proceedings of the workshop will be published by NRAO in the near future.

Steve Spangler and Bill Cotton

140-FOOT SYSTEM UPDATES

A number of software modifications have been made to the 140-foot observing system:

RDVLBI	allows VLBI observers to load observing decks into the Modcomp directly from the HP computer.
PDELAY	new adverb which allows removal of a prespecified time delay from continuum scans.
LISTHP	allows a VLBI observer using the HP to list any file containing 80-column card images on the Modcomp's Versatek printer.
CONVOLVE	performs a convolution of the current pointing scan with the upper half of a Gaussian beam.
CPOINT	performs pointing as in POINT, but uses a Gaussian convolution rather than Gaussian fitting scheme.
TIME	tells the telescope operator (via his Tektronix 4023 terminal) what time (LST, EST, GST) the Modcomp thinks it is.
AUTOBAL	provides automatic balancing of the autocorrelator.
MANUALBAL	ensures that the autocorrelator will enter its balance cycle only when an explicit command (BALANCE) to do so is given.

The procedure PVLS has been modified so that it is no longer necessary to input an even number of sources. The major revision is that the solution for new values is now performed by a least squares fit to the input pointing data rather than a simple averaging as was done previously.

Please contact Marc Damashek for further details.

Marc Damashek

36-Foot

THE "SUMMER" MAINTENANCE PERIOD

The 36-foot telescope again becomes unavailable for astronomical use on July 15. The onset of the summer rainy season increases the atmospheric water vapor over Kitt Peak, decreasing the atmospheric transparency for millimeter waves. And so, it is our custom to discontinue observing during the summer.

This year, the telescope will return to service on or about January 15, 1983, rather than in September after the end of the rainy season. The extended maintenance period will be used to install a new 12-m surface on the old mount on the 36-foot telescope.

Proposals for the new surface will be welcome at any time. The deadline for the first quarter of 1983 will be October 15, 1982. Initially, we plan to begin observations either with the new 230-GHz mixer or the repackaged bolometer so as to take advantage of the dry winter atmosphere.

Although the resurfacing project is following the planned schedule well, many critical steps have yet to be taken. A study of the thermal stability of the new back structure, the setting of the surface plates to a high level of accuracy, and the installation of the new or repackaged receivers will take place in the fall of 1982. Any one of these could run into problems and thereby delay the availability of the new telescope surface.

Mark Gordon

NEW RECEIVERS

As discussed at the last NRAO Users' Meeting, the millimeter-wave receivers at the NRAO are changing.

The new 1-mm spectral line receiver will cover the range 200-250 GHz. Laboratory measurements give a receiver temperature of less than 500 K, single sideband. The receiver may be tunable above 250 GHz, but its upper range depends on the availability of triplers and klystrons.

For continuum work, the He^3 bolometer is being repackaged for the 12-m surface. Its filters will cover the 2-mm, 1-mm, 0.8-mm, and 0.7-mm atmospheric windows. The sensitivity of the present bolometer (with the 36-foot telescope) is 5-8 Jy in 1 second at 1 mm. We expect the sensitivity of the repackaged bolometer (with the 12-m surface) to be about 1 Jy in 1 second at 1 mm.

There will be a new 70-120 GHz receiver. The laboratory measurements show a SSB receiver temperature of about 200 K at 115 GHz. A special feature is a quasi-optical system which terminates the image sideband in a 15 K load. This receiver probably won't be available until later than January 15, 1983.

The new surface has been designed to accommodate the older receivers, if necessary. The old 70-120 GHz receiver can be used until the new one is available. The older 2-mm and 9-mm receivers can also be used on the 12-m surface.

John Payne

COMPUTER PROGRAM

Primarily for reasons of available personnel and monies, the computer system for the new 12-m surface will remain nearly as it now is. One exception is the continuum package. We expect the telescope to be used more for continuum observations than it has been. This increase in demand provides justification for writing a comprehensive analysis program for this kind of data.

We are looking for suggestions. If you feel strongly about the best way to take and reduce continuum data, please contact Betty Stobie in Tucson.

Mark Gordon and Betty Stobie

THE 1981-82 OBSERVING SEASON

Even at the close of its life, the 36-foot telescope continued to be in as high demand as for any other NRAO telescope (including the VLA). From July 1, 1981, through June 30, 1982, 111 visiting scientists used the telescope, in addition to 11 students and 8 members of the NRAO research staff. They represented 48 institutions. Only 6% of the available observing time went to NRAO staff.

Mark Gordon

VLA

The NRAO-VLA WORKSHOP ON SYNTHESIS MAPPING

Eighty-five enthusiastic astronomers travelled to Socorro, New Mexico on June 20, 1982, to attend the week long NRAO-VLA workshop on aperture synthesis. The number of attendees far exceeded that anticipated and several came from as far as Japan and Europe.

In the weeks before the workshop NRAO scientists were busily preparing written and oral presentations about the theory of aperture synthesis and its application to the VLA. The results were 15 one-hour lectures, presented on Monday, Tuesday, Thursday and Friday with a VLA site visit on Wednesday. Over 100 people attended the lectures which were presented in Macey Auditorium on the New Mexico Tech campus. The lecture titles and speakers were:

Lecture	Title	Speaker
1	Introduction and Basic Theory	A. R. Thompson
2	Map Plane--(u,v) Plane Relationships	R. A. Sramek
3	Signal-to-noise Ratios	P. J. Napier/P. C. Crane
4	Calibration	R. M. Hjellming
5	The Effects of Bandwidth and Similar Problems	A. R. Thompson
6	Polarimetry	R. C. Bignell
7	Digital Cross Correlators and Cross-Correlation Spectroscopy	L. R. D'Addario
8	Spectral Line Observing	A. R. Rots
9	Image Restoration (and the Clean algorithm)	T. J. Cornwell
10	Large Field Mapping	B. G. Clark
11	Image Display, Restoration and Analysis	E. B. Fomalont
12	Common Map Defects	R. D. Ekers
13	Self Calibration	T. J. Cornwell
14	VLA Observing Strategies	A. H. Bridle
15	Advanced Spectral Line Problems	J. H. van Gorkom
16	Open Session for General Discussion	

After suitable revisions the lecture notes will be published in a reference manual for distribution to the participants and other interested people.

The responses from the participants after the workshop concluded were uniformly positive about the experience of the week's deluge of aperture techniques. Over half of the particpants were graduate students in astronomy or recent Ph.D.'s who had very little prior contact with the VLA, and we expect that many of them will become major users of the VLA over the next several years. Many suggested that more time should be spent at the VLA in the future workshops so that many of the topics discussed in the lectures could be more adequately and completely demonstrated.

The workshop was organized by Dick Thompson, Ron Ekers and Dick Sramek and the myriad of administrative and organizational details were smoothly handled by Sheila Thompson (of New Mexico Tech) and Eva Jean Rigby. For the 13 lecturers not having to ride the bus to the VLA site for a week was ample reward for their fine efforts in preparing a well-organized and clear compendium of present day synthesis techniques.

Ed Fomalont

VLA COMPUTER DEVELOPMENTS

The mapping system on the PDP-11/70 (Mapper) with its control system (MAPCON) is now working successfully. Maps can now be made on this system by issuing requests from the DEC-10; one visiting observer processed 1000 maps in a week. The CLEAN and self-calibration programs are also available for use.

The image display system (IMPS) has been installed on a PDP-11/44 and is functionally identical to the previous version that ran on a PDP-11/40, but has much increased performance mainly due to the superior processor speed. The time to produce a contour diagram has been reduced by a factor of 3, and the times for some other functions are lower by as much as a factor of 4.

To increase the total available disk storage capacity on the VAX systems running AIPS at the VLA site, one disk drive has been temporarily added to each system. In addition, these drives have been configured to have a removable disk pack. This allows users with large data sets to be assigned a whole pack to keep their data permanently on disk, thus eliminating the need to perform bulk magnetic tape data transfers before and after each session.

In AIPS, the self-calibration algorithm has been implemented for spectral line data and is known to work reliably. Also available is a new color display for the spectral line data cube. In this representation the intensity is proportional to the integral in the velocity dimension and the hue is proportional to the mean velocity.

Gareth Hunt

A CHANGING OF THE GUARD

Frazer Owen is our new Newsletter Correspondent for VLA affairs. He replaces Steve Spangler who is leaving NRAO to take up an assistant professor position at University of Iowa this fall. We thank Steve for a job well done over the past year, and express our appreciation to Frazer.

The Editor

In General

USE OF AIPS REDUCTION SYSTEM IN CHARLOTTESVILLE

After a slow start, the AIPS reduction systems in Charlottesville are now being frequently used. Since the beginning of 1982, twenty-two groups have used the facilities for an average duration of 4.2 days each. Thus on average the facilities are in use by non-NRAO staff 45.8% of the time, or 23% of the time for each of the two computers. In actual fact, the VAX 11/780 is noticeably more popular than the Modcomp Classic, which is slightly less friendly but otherwise comparable in all respects. These figures should indicate that the Charlottesville facilities are considerably less crowded than those at the VLA and can absorb significantly more outside usage.

The Editor

UNIQUE FOREIGN TELESCOPES

As a vehicle to encourage additional persons to take advantage of the available NSF travel funds for U.S. observers to unique foreign telescopes, the following is a complete list of telescopes which have been used so far: Bonn 100 m, Nancay, Onsala 20 m, Parkes 65 m, Ratan 600, Tidbinbilla 64 m, and Westerbork array.

R. J. Havlen

MODIFICATION OF PAGE CHARGE SUPPORT FOR VLBI PAPERS

The NRAO will no longer automatically support a minimum of 50% of the page charges for papers reporting new data obtained in VLBI experiments involving NRAO telescopes. Henceforth, NRAO page charge support will be limited to the fraction of NRAO telescope involvement or staff member authorship, whichever is greater. The minimum support level for qualifying papers will not be less than 10%, however.

R. J. Havlen

INTERNATIONAL HALLEY WATCH

The NRAO is planning to participate in radio astronomical observations of Comet Halley in 1985-86 in cooperation with the International Halley Watch (IHW). Potential comet observers should contact William Irvine and Peter Schloerb (Massachusetts) in order to learn more about the details and scope of coordinated radio observing efforts. The NRAO will entertain scientific proposals for any of its facilities (12 meter, 140-foot, VLA) to be refereed in the normal manner in competition with proposals in other areas. Blocks of observing time will probably be reserved in advance according to IHW specifications. Accordingly, all comet investigators are strongly urged to submit their proposals with as much anticipation as possible in order to insure adequate treatment of technical and logistic considerations.

R. J. Havlen

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