NRAO NEWSLETTER

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IN GENERAL

Martha P. Haynes Elected Interim President of Associated Universities, Inc.

Dr. Martha P. Haynes, a distinguished Professor of Astronomy at Cornell University, on April 9th became the Interim President of Associated Universities, Inc. (AUI). She was elected by the Board of Trustees of this independent non-profit organization, founded by nine northeastern universities, which operates the National Radio Astronomy Observatory (NRAO) under a cooperative agreement with the National Science Foundation. Dr. Haynes, a Trustee for the past four years, will lead AUI while it seeks a successor to Dr. Lyle H. Schwartz, whose resignation became effective April 8, 1998.

In tendering his resignation, Dr. Schwartz explained, "For many months, the Board has known of my plan to move on soon after management of Brookhaven National Laboratory (BNL) passed to Brookhaven Science Associates. For the foreseeable future, AUI will be better served by a President from the astronomy community, while I can contribute more in a position where my background in materials science and engineering is more relevant."

"I shall always treasure my warm relationship with AUI and the friends I made at BNL and NRAO," he observed, "and sadly recall the strange sequence of events that made my hopes and plans for BNL moot. Scientists everywhere deeply respect the wisdom of the AUI Board and its commitment to strengthening and encouraging the best possible science under conditions in which all can take pride."

Dr. Paul Martin, Chairman of the Board of AUI and a professor and dean at Harvard University, extended the Board's gratitude to Dr. Schwartz for his remarkably effective performance during a year of transition. "It comes as no surprise," Martin noted, "given his success as a Laboratory Director at the National Institute of Standards and Technology and at Northwestern University. We wish him every success in his next position."

"As AUI looks to NRAO and the future," continued Dr. Martin, "we thank the stars that Dr. Haynes can step in. With her experience as a researcher at many major optical and radio astronomy observing facilities worldwide; her long association with NRAO including service as Director of the NRAO facility in Green Bank, West Virginia; and her thorough understanding of the strengths of AUI management as an active member of the AUI Executive Committee, she's the ideal person to take the reins as we search for a permanent new President, restructure, and forge closer ties with universities and the astronomical community."

In accepting the responsibilities of Interim President, Dr. Haynes commented, "This is an exceptionally exciting time for NRAO, within sight of the completion of the Green Bank Telescope and the anticipated initiation of the Millimeter Array project. The radio astronomy community has long held AUI in high regard, particularly because of the prominence, breadth and personal involvement of its Board membership. My acceptance of this interim position is a direct reflection of the AUI commitment to maintaining NRAO's preeminence in radio astronomy as we enter the 21st century."

P.C. Martin (AUI)

Reorganization of Observatory Computing

Effective March 5, 1998, Richard Simon joined the Millimeter Array project management team with responsibility for developing and maintaining the schedules, cost estimates, and other planning and reporting requirements of this major new Observatory project. I want to take this opportunity to thank him for his service during the past five years as Assistant Director for Computing.

Rather than appoint a new Assistant Director for Computing, we have instituted a new approach to the management of Observatory-wide computing. An Observatory Computing Council has been appointed to formulate and recommend strategy and policy for NRAO computing. The members of the Computing Council are: A. Beasley, A. Bridle, T. Cornwell, J. Mangum, P. Murphy, G. van Moorsel, G. Hunt. Alan Bridle will chair the Council. Ruth Milner has been appointed Assistant to the Director and will serve as the executive officer of the Council. Ruth will continue to be based in Socorro. The membership of the Council is intended to be representative of major software projects, operating sites, and the scientific staff. Input from the user community is welcome at any time and should be directed to Alan Bridle or any Council member.

Finally, since the beginning of the year Gareth Hunt has had responsibility for computing in Green Bank generally, in addition to his duties as head of computing for the Green Bank Telescope. Ruth Milner has been filling in for Gareth, as acting head of Charlottesville computing. With her departure for Socorro, Patrick Murphy has been appointed to this position.

P.A. Vanden Bout

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Observatory-Wide Computing Developments

In October 1997, a Tektronix Phaser 560 color laser printer was purchased for testing at NRAO Charlottesville. While the quality of the output is perhaps not as high as could conceivably be achieved, it is clear that it cannot be improved upon without spending three or four times as much money. In light of this fact, and that the 560 performed as well as, or better than, other models in its price range, in December we purchased identical printers for the other three main NRAO sites (Green Bank, Socorro, and Tucson). Advantages of the new printers include higher resolution, faster throughput, better color representation, and much lower cost per page, especially for hard copies. They will provide significantly better color printing facilities than were previously available.

Also in late 1997, NRAO purchased two DLT7000 tape drives. This type of drive has considerably higher capacity and transfer speed than the most commonly-used tape media (8 mm and DAT), and may be useful for storing and transporting large datasets. The two drives, located in Socorro and Charlottesville, have successfully been used for loading and backing up large datasets in AIPS. Unfortunately, one of the two drives malfunctioned in February and had to be returned to the vendor for repairs. Concerns about the robustness of the DLT hardware and its media mean that we should also evaluate other high-speed tape technologies, such as Exabyte Mammoth, as the budget permits. However, the price of this equipment currently prevents wide deployment within NRAO.

During 1997, a total of approximately 65 Sun SPARCstation 1s and IPCs were traded in for Ultra 1/170s. This represents substantial progress in the replacement of NRAO's aging population of desktop workstations; however, there are still roughly 110 Suns across the observatory which are at least five years old. We are hopeful that this effort will continue in 1998. One of the factors in the choice of upgrade path is system performance as illustrated by the AIPS DDT benchmark. Recent efforts in this area have yielded significant improvements on Intel PCs running Linux. A detailed article on this subject is included in the April 15, 1998 issue of the AIPSletter.

Significant progress has also been made in other areas of PC-based computing. In particular, NT servers have been purchased in Socorro and Green Bank; one is also planned for Charlottesville in 1998. Support staff at the three sites are working together to create an NRAO-wide NT domain, to facilitate central authentication, co-ordination of user services, and filesharing between PC users at all NRAO locations.

Computing security is an ongoing concern. Recent improvements in this area include the availability of "ssh" at three of the four major sites, increasing use of "tcpwrappers" to log outside connections so that unusual activity can be identified, and a plan to purchase a site license for PC anti-virus software.

When the Year 2000 (Y2K) arrives, the potential exists for many computer systems, software, and 'smart' hardware containing embedded microprocessors to malfunction, if not updated or replaced by then. The convention of using two digits for the year instead of four has created a serious problem for date-aware software and hardware.

NRAO's project to identify and resolve Y2K related issues is well underway; all possible areas of risk, including use of date-aware software, communications and networking infrastructure, computing hardware, safety and environmental systems, embedded microprocessors, use of customized routines for financial tracking and reporting, and so on, were considered. No major surprises turned up. Since the Observatory's critical functions are not dependent upon large amounts of internally written, date-sensitive software, and since the Observatory has considerable hardware expertise to deal with the minor hardware problems associated with the Year 2000 transition, no major difficulties associated with Y2K are foreseen. All critical systems and functions at the NRAO, including AIPS, AIPS++, and the major telescopes, have either been tested already, or are scheduled for testing during 1998 to identify and correct any remaining small problems associated with Y2K. Contingency plans will be formulated in the event that critical outside vendors experience Y2K-related difficulties.

R.L. Milner

AIPS++ Project

The AIPS++ Project now has an on-line newsletter, edited by Bob Hjellming and Kate Weatherall. This is published monthly and may be found from our home page off the NRAO home page or directly from: http://aips2.nrao.edu/aips++/docs/newsletters/frontpage.html. A sample is appended at the end of this Newsletter.

The AIPS++ newsletter will contain news on the project, accounts of various uses of AIPS++ by different groups, background information on the various capabilities of AIPS++ (such as Glish and the Measures system), and a Programmer's Corner (currently demonstrating the capabilities of Glish for convolution).

T.J. Cornwell

Charlottesville Computing Developments

At the end of 1997, the rapidly aging IBM RS/6000 system "polaris," which was for over six years the main general purpose UNIX system and file server in Charlottesville, was replaced by two SPARC Ultra 1/170's. One of these is now the "new"' polaris and serves login accounts and general purpose computing; the other is a dedicated NFS (file) server.

Significant consolidation of ftp service is planned for the coming quarter. The separate aips.nrao edu and ftp.cv.nrao.edu servers will be merged (though the names will not change) and served from a 4-processor Sparc-10 system. This should improve the performance for anyone downloading AIPS or other general files from the Charlottesville server.

Several Charlottesville Computing staff members are involved in an effort to make it easy for other NRAO sites (and the general Astronomical Community) to install Linux and AIPS, including plans to release the next version of AIPS on CDrom with "live" binaries.

P.P. Murphy

Thesis Students

Among the many functions of the NRAO library is that of being an archive for the PhD thesis research done by students on the NRAO telescopes. If you, or one of your students, made observations at the NRAO that became part of a PhD thesis, we would very much like to have that thesis included in the NRAO library holdings. Please send two copies (if possible), bound or unbound, to:

Librarian
NRAO
520 Edgemont Road
Charlottesville, VA 22903

While we would like to have all recent theses, we are also very much interested in having a complete collection of theses: even if your work was done long ago we would appreciate having a copy of it. The more complete the archive of theses is the more will be its value in the future.

I would appreciate your help in making this request known to others.

R.L. Brown

Millimeter Array

Shortly after the first of the year, Associated Universities, Inc., submitted to the NSF the Program Plan for the initial three-year Design and Development Phase of the MMA. The Program Plan outlines the tasks to be accomplished in the D&D program and it illustrates the schedule for those tasks; staffing and budgetary estimates are included. The MMA D&D project goals include the following:

- Definition and implementation of an organizational and management structure that will serve the entire MMA project.
- A comprehensive proof-of-concept for the MMA instrumentation through construction of prototype hardware.
- A plan for integration of prototype hardware on a test interferometer. Establishment of a firm cost basis for the MMA by means of prototyping.
- Involvement of interested MMA international partners early in the instrumentation design and prototyping work.
- Continuing involvement of the U.S. community in development of the MMA and fostering of the long-term vitality of U.S. university-based millimeter-wave research and development groups.

The MMA Program Plan was reviewed by a NSF Millimeter Array Oversight Committee (MOC) that met for this purpose in late February. The report of the MOC is expected at the end of March. The report will be used as input for a decision to be made by the National Science Board in May regarding authorization to expend the funds appropriated by Congress in 1998 for the MMA.

Discussions with European and Japanese groups interested in partnering in a common large array project have led to specific joint studies and actions. Some ideas are still evolving stimulated recently by a meeting of the U.S. and European technical working group heads held in Charlottesville in March, and by a meeting of the U.S., European, and Japanese site testing groups held in Tucson also in March.

Reports of the joint meetings, and news of all recent developments with the MMA, are being reported to the community via an experimental MMA electronic Newsletter. The MMA Newsletter, that includes hypertext links to the meeting reports and all other recent MMA documents, is being emailed to more than 300 individuals who have been involved with the MMA one way or another recently If you have not received the initial emailing of the MMA Newsletter, and you are interested in being on the email list, please contact Kate Weatherall (kweather@nrao edu). The purpose of the Newsletter is to establish a dialog with the community—your views and opinions are solicited; as the project proceeds we welcome, and indeed rely on, your participation in the MMA decision-making process.

R.L. Brown

Observatory Response to the Millimeter Array Advisory Committee Recommendations Report from the Meeting of November 15, 1997

The report of the Millimeter Array Advisory Committee (MAC) following their meeting of November 15, 1997, appeared in the January 1, 1998, issue of the NRAO Newsletter. It can also be found on the NRAO web site. Since that meeting of the MAC, the Committee's recommendations have been considered by the Observatory and this article presents the current position of the NRAO on the recommendations. Let me begin by thanking the Committee for assembling on rather short notice and for the time and hard work they invested in the meeting.

The Committee endorsement of the potential merger of the Millimeter Array (MMA) and the Large Southern Array (LSA) was welcome. We are continuing to work with the Europeans to achieve this goal, using the working groups in science, antenna and systems, receivers and electronics, and management. We are also, as the Committee recommended, keeping our options open with respect to the Large Millimeter Submillimeter Array (LMSA) project of the Japanese. A renewal of our Memorandum of Understanding governing this cooperation with the LMSA is being negotiated.

The Committee recommended against a heterogeneous array, opting instead for a homogeneous array of antennas of common diameter That is the current NRAO plan. The Committee also recommended that the design effort be concentrated on an antenna diameter of 12 meters and that the "fall-back" issue should not dominate further discussion of antenna size. Because the National Science Foundation has required us to submit a plan for the design and development phase of the MMA that is specific, complete, and as independent of uncertainties regarding potential partners as possible, we have adopted as the baseline, stand-alone plan for the MMA a homogeneous array of 10 m diameter antennas. This in no way precludes the modification of the antenna size should partnership arrangements be realized, nor does it indicate any change in the interest in such partnerships. Ten meter diameter antennas are the largest that are consistent with a stand-alone MMA, and, therefore, the largest step we can take *at this time* toward accommodating the wishes of both the Europeans and the MAC for larger antennas in a merger of the MMA and LSA. Should sufficiently concrete partnership arrangements be put in place in the next year or so, and should our studies of a 10 meter antenna design be encouraging, it will still be possible to place a contract for 12 meter diameter prototype antennas.

A fully international advisory committee is a necessity when partnerships with the European and/or Japanese projects have been realized. In the meantime, we have decided it would be better to proceed with a separate advisory committee that includes observer-members from the other projects. Accordingly, we will be reorganizing the MAC somewhat to reflect this, also adding Japanese observers. It is also likely that interested members of the Board of Trustees of Associated Universities, Inc., will be invited to attend the MAC meetings. An international science meeting is under consideration.

Effective management structures for the partnerships we are trying to achieve are a constant topic of discussion. There is a joint MMA–LSA management working group that meets regularly just for this purpose. The Millimeter Array Development Consortium (MDC) is playing a very important role, and we fully intend to continue this arrangement, independent of partnership arrangements.

The Committee's concerns regarding software design and planning are noted, and it is planned to treat this area as equal to the other elements of the project.

P.A. Vanden Bout

International LMSA/LSA/MMA Site Testing Workshop

Representatives from the LMSA (Japan), LSA (Europe), and MMA (USA) projects met in Tucson on March 10 and 11 to discuss site testing in the area of Pampa la Bola and Cerro Chajnantor. They were joined by colleagues from Cornell, the Smithsonian SMA, CTIO, and Gemini. There was a review of measurements over the last three years consisting of meteorology, atmospheric transparency, and atmospheric stability, with particular emphasis on recent measurements at submillimeter wavelengths. This was followed by discussion of future, possibly joint, efforts to study the physical structure of the atmosphere, in particular the height distribution of water vapor and turbulence, and to test schemes for radiometric correction of interferometer phase.

S. Radford

The Westerbork Northern Sky Survey (WENSS)

Those of you who scan the world wide web sites may have noticed that the WENSS survey went public in the beginning of January 1998. This marks an important point in the seven years since we began observations for the survey in December 1990. Although the last observations were done in March 1996, the reduction was only completed in the summer of 1997. It has taken us a further 6 months to make the survey available on the web and to begin production of the CD-ROM and Atlas. The web address where you can find the survey is: http://www.strw.LeidenUniv.nl/wenss.

What You Can Find in the Survey — WENSS covers declinations from +30 degrees and up and includes the galactic plane at a resolution of about 1'. The survey frequency was 325 MHz, the bandwidth 4.5 MHz. The images (frames) of 6x6 degrees, at 1024x1024 pixels each, are located at the central positions of the new POSS II survey plates. The frame centers are spaced 5 degrees. There is a total of nearly 500 frames with some overlap around the transition to the polar cap. The region above declination +74 degrees was done with the broadband continuum backend with 8 bands of 5 MHz. The central frequency in the polar cap was about 350 MHz. We have also made images with a resolution of 4.2'; they will be made available soon.

A description of the survey and catalog is given by Rengelink et al. A&AS 124, 259 (1997). This description was based on the reduction of about five percent of the survey, and more complete information will soon be available on the web and in Rengelink's thesis.

What you will not find in the public survey products is polarization information. We regret this very much since low frequency polarization can be a very interesting diagnostic. We have made beautiful polarization images of the galactic foreground polarization in several nighttime mosaics but we discovered that ionospheric Faraday rotation in the first two to three years of the survey was often extremely large and variable. Rotation of the plane of polarization of well over 180 degrees around dawn or sunset was no exception. What was worse, however, was the fact that this was not well predictable on the basis of available ionosonde data. A polarization self-calibration scheme has been developed but is rather laborious to implement. We therefore stopped the reduction of the polarization images until we have better ionospheric TEC data available and more manpower.

The original WENSS goals also included observations at 610 MHz (49 cm) for a significant part of the northern sky away from the galactic plane. However, the pressure for time on the WSRT was too large to achieve this goal and we opted for completing the 325 MHz survey. Although we have acquired, and reduced, most of the 49 cm data time (a total area of about 2000 square degrees), manpower restrictions prevent us from making this data available in a uniform and reliable format. Perhaps at some future date we will, but don't hold your breath.

Data Quality — The noise level for the polar cap region was about 2 mJy against 3-4 mJy in the middle declination zone. However, the noise level can be considerably higher at places (near extended 3C sources or in the Galactic plane). The dynamic range also can vary substantially. Strong point sources, even when as strong as 56 Jy (3C147), leave no image artifacts around them. Slightly extended sources, on the other hand, often do not self-calibrate well. Please note that the WENSS flux scale, based on the Baars et al. flux of 3C286 (26.93 Jy at 325 MHz) differs from that in use at the VLA by about five percent.

Those of you who have been involved with bulk processing of aperture synthesis data know that several compromises have to be struck. Automated procedures for the data reduction (including calibration, data flagging, self-calibration, imaging, and CLEANing) of up to 6000 pointings prevent the removal of many obvious errors. Error patterns for east-west synthesis arrays are easier to spot than those affecting e.g. VLA images and the experienced eye can easily spot them. It is obvious that we cannot guarantee the reality of everything there is to be found in the survey. Consult an experienced observer in case you are in doubt about a possibly interesting feature.

Each frame contains data obtained from the primary-beam-weighted combination of up to ten different pointings (separated by 1.3 degrees). These pointings may occasionally have been observed up to several years apart! Each pointing is sensitive to an area of about 3 degrees diameter (the HPBW=2.7 degrees). Errors can therefore vary substantially, even within a frame.

Here Are Some General Warnings — 1) Pointings where the dominant source is extended at the 10"-60" level (i.e., just about one synthesized beamwidth) will often produce artifacts close to the source ("ears," etc.; see e.g., the fields around 3C69 and 3C123). These usually are the result of imperfect self-calibration. In an east-west array source structure and systematic gain/phase errors can not be easily separated.

2) As is well known, standard self-calibration requires position invariant complex gain errors. Non-isoplanaticity at low frequencies violates this assumption. It has occasionally affected the image quality leading to spiky patterns. Errors resulting from non-isoplanaticity usually affect all BUT the strongest source in individual pointings. A good illustration of the transfer of ionospheric phase fluctuations is the field

containing the sources 3C380 and 3C381. However, sometimes such spikes are the result of interstellar scintillation (e.g., note the image around PSR B0329+54)!

3) The flux densities at the lower end of the survey may still contain a systematic bias at a level of 1-2 mJy. This bias probably varies from field to field, and even within a field, depending on variable factors like the source distribution, the depth of the CLEAN, the number of working telescopes, and the number of 12^h syntheses that went into the image. Because the thermal and (sidelobe) confusion level is 3-4 mJy at best, we have not systematically analyzed this bias.

4) Within the Galactic plane there are obvious problems with missing short spacings, "solar fringes" and the areas around Cyg A and Cas A.

It is obvious that this project required the work of many people so let me end by naming the people who have contributed to the survey. The project was a joint effort of the Netherlands Foundation for Research in Astronomy and the Leiden Observatory. George Miley was instrumental in getting the survey started, arranging for financed manpower, and providing stimulating support throughout the project. Yuan Tang, based in Dwingeloo, tirelessly did most of the data reduction on one, and later, two HP workstations. In Leiden, Roeland Rengelink, and Martin Bremer in the first two years of the project, wrote the software to produce a wonderful catalogue. And Roeland, of course, wrote a whole thesis on WENSS, which should be out shortly. What he learned has benefitted the whole project.

Huub Rottgering and Malcolm Bremer joined the project after a few years and have been a big help with many aspects, including the scientific exploitation. Finally, now that the job is almost done, David Fullagar and Ernst Raimond are helping to make the survey available to the worldwide community, via a web interface, CD-ROM, and Atlas. You will make their efforts worthwhile by using and/or buying the survey products.

A.G. de Bruyn (NFRA)

GREEN BANK

140 Foot Telescope Status

The final deadline for receipt of 140 Foot Telescope proposals was 30 March ,1998. From now on, the only proposals that will be accepted will be for observations of a unique event such as a comet, or for use of small bits of otherwise unassigned time. It is expected that there will be very little time available in the latter category. By mid May we plan to send out a status report to everyone who has a proposal in the 140 Foot queue giving final information about scheduling. At the end of 1998 the 140 Foot Telescope will be closed as a user facility, and certain receivers may be taken out of service even earlier than that if they are needed for GBT outfitting. There may be other limitations on telescope availability in the fourth quarter of 1998 if personnel are needed for the GBT.

F.J. Lockman

Green Bank Computing Developments

In collaboration with Charlottesville and Socorro, we have investigated the installation of an NRAO domain for Windows NT. The primary domain controller will be in Charlottesville. In Green Bank, we will have a Windows NT file server, which will be used as a backup domain controller. The server will serve AutoCAD, the Corel suite, and other common software to all site PC users. In addition, it will provide individual disk areas that will be routinely backed up. The tape units from the server will also be available for complete system backups for individual PCs. Two modern PCs running Windows NT are available to visitors.

We have exceeded the data capacity of the disks used to monitor equipment being developed for the Green Bank Telescope. So, in preparation for full operation of the GBT, we have already increased the size of the disk for storage of monitor data to 18 GB. Further, we have a need to track the component maintenance history for the GBT, so we are actively tracking the progress of the new product for this being acquired for the same purpose for the VLA and VLBA in New Mexico.

Several Suns were moved when the GBT mockup was relocated to it's final location in the Jansky Lab Addition. In the process, we upgraded them to Solaris 2.6. We were able to solve the problem of supporting multiple monitors on the operators' computers. The Suns used for the OVLBI ground station were also upgraded. The rest of the computers will be gradually upgraded during the year. The most difficult transition will come when we upgrade the local server (sadira) from SunOS 4.1.2.

G.C. Hunt

The Green Bank Telescope

The accompanying photograph of the Green Bank Telescope (GBT), taken in March 1998, shows that many of the basic elements of the tipping structure are in place atop the alidade. These include the elevation shaft, box structure, horizontal feed arm, the elevation wheel, bull gear and drive, and most of the main reflector backup structure (BUS). The 22 counterweight boxes on the elevation wheel are completely welded, and ten have been filled with concrete. The boxes are filled in a precise order to safely counterweight the BUS as additional modules are added into the structure. Primary elements of the servo and electrical systems have been installed on the alidade and the antenna is rotated frequently to aid in the erection process. Currently, the electricians are running conduit and cable trays from the elevation feed wrap out the horizontal feed arm.

The reflector BUS trial erection was completed on the 175 foot square concrete slab at the telescope in June 1997. The BUS consists of 7,652 different members and joints, weighing approximately 2.3 million pounds. During the trial erection, all joints in the BUS were aligned with a positional accuracy of ± 0.25 inches. When finished, the jacks at the top of the 110 scaffolding towers were retracted, leaving the BUS supported by the 17 reinforced concrete piers on which it was built. The deflected shape of the BUS under gravity load was measured to verify the predicted values of the finite element analysis. Lifting of its 22 modules onto the box girder began in October 1997. Currently, 17 modules are on the box and the remaining five are on the ground in the staging area in position to be lifted and placed in the BUS.

The Contractor has recently brought in an additional tower crane (Manitowoc Model 4100) to aid in the lifting and positioning of the remaining modules. Individual modules will be sequentially placed at the base of the main derrick, the surface panel support actuators will be installed, and the module will then be lifted and placed in the BUS. Modules vary in weight between 25 tons and 74 tons, the rigging used for lifting weighs an additional 40 tons, making the heaviest lift 114 tons. As the remaining modules are placed on the structure, they will be held aloft by the derrick cranes while the interconnecting beams between the modules are reinstalled for both stability and accurate positioning of the neighboring units. Completion of the reflector BUS and its permanent supports is scheduled for early December 1998.

The upper 60-foot portion of the feed arm was trial erected at the site, including the deployable prime focus boom, the prime focus positioning mechanism, the subreflector, and the subreflector positioning mechanism. The feed/receiver room, which is located directly below the upper feed arm, has been located nearby with the secondary focus feed turret in its roof. The feed arm servo, which controls all of the above-mentioned equipment, has been installed and tested along with some of the NRAO monitor and control hardware. The first photogrammetric setting of the subreflector surface and calibration of the six subreflector "Stewart platform" actuators has been accomplished to within 0.007" RMS. Additional photogrammetric measurements are anticipated to allow final setting of the subreflector to a tolerance somewhat better than 0 004" RMS.

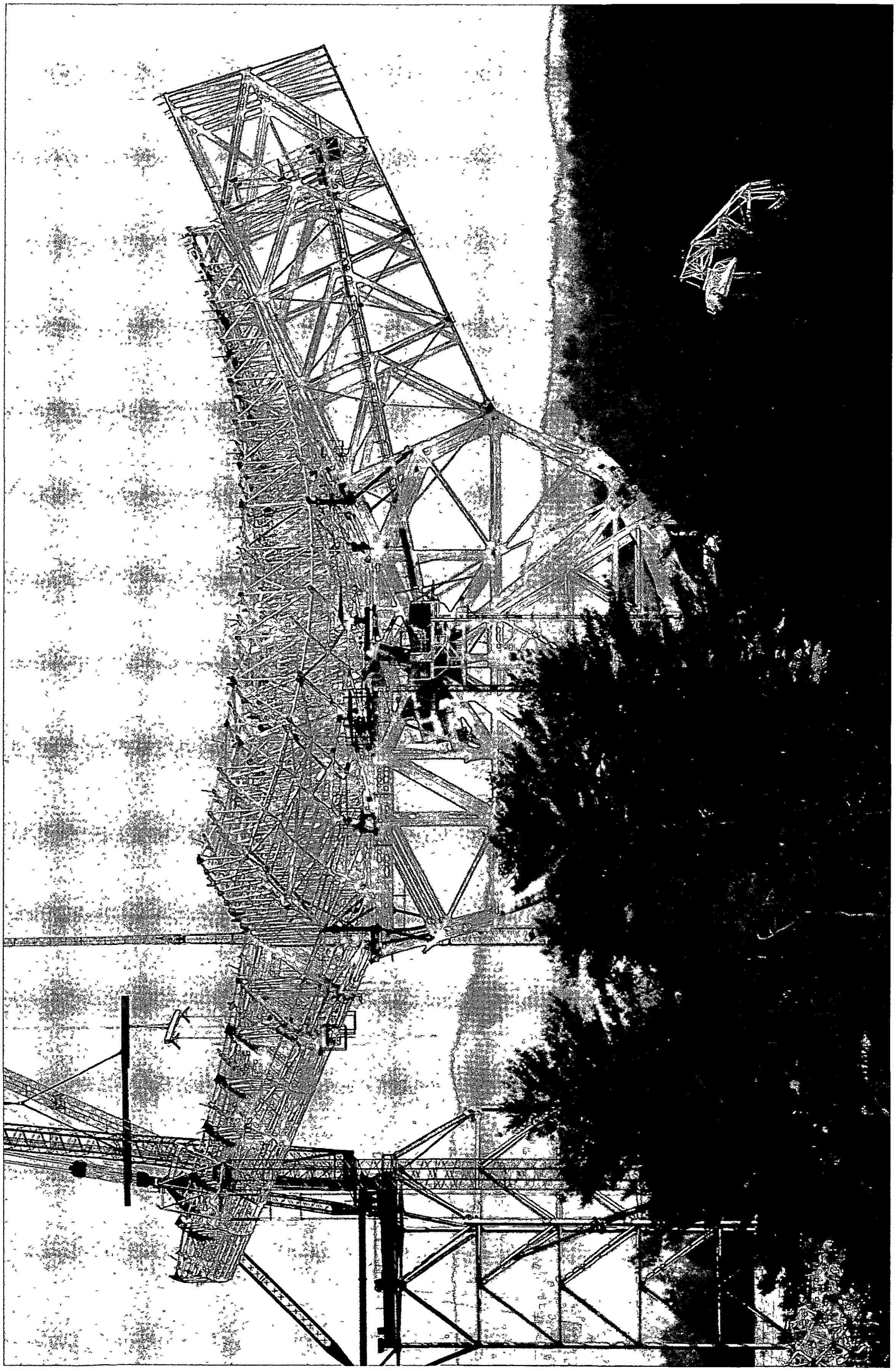
The 200-foot dual tower section of the vertical feed arm was trial erected at the Contractor's fabrication plant in Mexia, Texas. It was disassembled and shipped to Green Bank where final assembly is now underway. All steel is on site, and the first elements of the vertical feed arm have been assembled and on the ground.

The 2,004 main reflector panels are now in production at the Contractor's plant. Approximately 1,400 panels have been manufactured. Nine of 44 tiers have been accepted by NRAO, and painting has begun. Several of the larger panels have been sent to the site where they were positioned on the structure as a comprehensive fit and alignment check for the structure, actuators, panels and cabling. Subsequent return of the panels to the Contractor demonstrates that the shipping method is acceptable and will not degrade the accuracy of the precision built panels.

The schedule for completion of the telescope is now mid-November 1999. Most of the delay of nearly one year is due to problems in the permanent supports of the back-up structure. The rest can be accounted for by allowance for bad weather and schedule contingency. Close inspection of the 16 permanent supports has revealed that most need to be rebuilt. This is due to errors in design and/or faulty fabrication, specifically, poor quality welding of the interior stiffness. Because these supports are critical to the structural integrity of the GBT, they must be rebuilt in spite of the consequences for the schedule.

On March 17, 1998 Comsat announced the sale of its subsidiary Comsat-RSI, the contractor for the GBT. The buyer, a Dutch company known as TBG, does not want the obligation of the GBT contract, and Comsat itself will finish the telescope. To do so, Comsat has retained key members of the current GBT project management team at CRSI and placed them under the leadership of John Evans, Comsat Chief Technical Officer. John is well known to many radio astronomers from his years with Lincoln Labs and as director of Haystack Observatory prior to becoming head of Comsat Labs. The sale is waiting for government approval.

R.D. Hall and W.H. Porter



CONSTRUCTION PROGRESS OF THE GREEN BANK TELESCOPE (GBT)

VLBA/VLBI

Space VLBI at the AOC

Progress continues in observing and correlation of VSOP experiments with the HALCA spacecraft. The observing load on the VLBA now has reached about the maximum sustainable for the L and C band proposals available, subject to the current constraints on sun angle and maneuvering.

As of the end of March, a total of 75 VSOP experiments had been observed on the VLBA, including 53 scheduled from General Observing Time (GOT), spanning 516 hours, or more than 25 percent of NRAO's commitment of 2000 hours to the first Announcement of Opportunity. Ten of the GOT observations are to be processed at other correlators, while almost as many, nine observations, with non-VLBA ground arrays were or will be correlated here. Another 13 observations were abandoned due to known or unknown failures on the HALCA spacecraft or at tracking stations. Thus, at the end of March, the VLBA correlator had released 58 VSOP observations, spanning 583 hours and 6320 HALCA baseline-hours, with three experiments awaiting tapes or reconstructed orbits, a backlog of about ten days.

The transfer of responsibility for VSOP observations from the NRAO Space VLBI Project to the AOC Operations Division is essentially complete. Project personnel now have more time for careful analysis of the observations. One recent development of this type was an extensive analysis of the coherence on baselines to HALCA, using data from more than ten VSOP observations. When the spacecraft is farther than about an hour from perigee, coherence times are about 600 seconds at L band, and 300 to 500 seconds at C band — in accord with pre-launch predictions. Closer to perigee, the coherence times are shorter by factors of two to three, apparently due to variations not modelled correctly in the orbit reconstruction. These results verify that all relevant components of the VSOP observing system, including the two-way phase-transfer links from the tracking stations and the application of the resulting time corrections at the VLBA correlator, are performing properly.

J.D. Romney

VLA-Pie Town Connection Status Report

Work has commenced on the effort to produce a real-time connection between the Pie Town VLBA antenna (PT) and the VLA, which would double the effective resolution of the VLA in its A configuration. We are fortunate to have Ron Beresford working at the AOC, on leave from the Australia Telescope, where he played a key role in the local implementation of fiber optics. He is serving as the system engineer for the link development. Information on the proposal and the goals of the link were described previously in Newsletter No. 73. The near-term goal is to produce first fringes over the link, using only one intermediate frequency (IF) channel and an interim system, near the end of 1998, or in early 1999.

A system-level block diagram for the VLA-PT link has been completed, making extensive use of spare VLA modules at Pie Town Fringe rotation will be performed at Pie Town, where the VLBA intermediate-frequency (IF) data also will be converted to VLA-compatible frequencies before the analog data are transmitted (by laser) over commercial fiber-optic lines to the VLA. After the IF data are demultiplexed from the transmission line, they will be fed into an existing VLA D-rack in much the same way as the signals from any other VLA antenna.

Use of PT with the VLA requires a much larger delay capability in the VLA correlator, due to both the extra geometric delay and the 500 microseconds of delay for the optical-fiber transmission between Pie Town and the VLA control building. Modifications of the correlator delay cards that will accommodate delays as large as 800 microseconds (vs. a maximum required delay of 690 microseconds for the link) have been designed, and prototypes are being produced. In addition, the impact of the large additional delay on the 1.6-millisecond data-invalid cycle when the control building "talks" to the VLA antennas is being studied. Modifications of the sequencing of various tasks have been tentatively identified in order to prevent invalid data from appearing at the correlator when valid data are expected.

Several possible options have been identified for scheduling of the VLA-PT link, including modifications to either the SCHED or the OBSERV programs that are normally used to schedule the VLBA and the VLA, respectively. It is anticipated that there will be an intermediate stage of testing during which the most efficient means of scheduling will be explored, before a final decision is made about the scheduling interface that will be recommended for observers.

J.S. Ulvestad

VLBA Status

VLBA Amplitude Errors — Significant amplitude errors (typically 5-10%) have recently been identified in the raw data produced by the VLBA correlator, mainly for narrow-bandwidth [≤ 4 MHz] observations using oversampling (sampling at integral multiples of the Nyquist rate). The corrections required depend on the correlator FFT size, the recording oversampling factor and fan-out used, and are constant (and predictable) factors for most observations. These errors result from FFT cycles being dropped from integrations due to timing considerations in the correlator, and have been present since November 1995 (VLBA correlator software version 4.14) when the playback weight normalizations were adjusted for these losses without a corresponding adjustment in the amplitudes.

The AIPS task ACCOR (available since 1995) will remove these amplitude errors. Most narrow-bandwidth observers also use 2-bit sampling to increase sensitivity, and therefore already run ACCOR by default. NRAO recommends that all observers using narrow bandwidths and/or over sampling run ACCOR on VLBA correlator data as part of amplitude calibration. If the observing mode (e.g., oversampling factor) changes during an observation, the solution interval for ACCOR must be shortened sufficiently so that time-variable corrections can be applied.

A planned restructuring of the FITS output of the VLBA correlator in late 1998 will address this problem, and we apologize for any inconvenience. If you have any further questions on this issue, please direct them to tbeasley@nrao.edu.

A.J Beasley

VLBI Network Call for Proposals

Proposals for VLBI Global Network observing are handled by the NRAO. Global network sessions currently planned are:

Date	Bands	Proposals Due
27 May to 10 Jun 1998	6 cm, 18 cm, 3.6 cm	01 Oct 1997
11 Nov to 02 Dec 1998	6 cm, 18 cm, 3.6 cm	01 Jun 1998

Five centimeter spectral line observations also will be available in November on the EVN The September EVN session will be devoted entirely to observations with the HALCA satellite.

It is recommended that proposers use a standard cover sheet for their VLBI proposals. Fill-in-the-blanks TeX files are available by anonymous ftp from ftp.cv.nrao.edu, directory proposal or via the VLBA home page on the WWW. Printed forms, for filling in by typewriter, are available on request from Betty Trujillo, Socorro.

Any proposal requesting NRAO antennas and antennas from two or more institutions in the European VLBI network constitutes a Global proposal. Global proposals *must* reach *both* Networks Schedulers on or before the proposal deadline date; allow sufficient time for mailing. In general, fax submissions of Global proposals will not be accepted. Proposals requesting use of the Socorro correlator must be sent to NRAO even if they do not request the use of NRAO antennas; proposals for the use of the Bonn correlator must be sent to the MPIfR even if they do not request the use of any EVN antennas. For Global proposals, or those to the EVN alone, send proposals to:

R. Schwartz
Max Planck Institut fur Radioastronomie
Auf dem Hugel 69
D 53121 Bonn
Germany

For proposals to the VLBA, or Global network proposals, send proposals to:

Director
National Radio Astronomy Observatory
520 Edgemont Road
Charlottesville, VA 22903-2475
USA.

Proposals may also be submitted electronically, in Adobe Postscript format, to proposevn@hp.mpifr-bonn.mpg.de or propsoc@nrao.edu, respectively. Care should be taken to ensure that the Postscript files request the proper paper size.

B.G. Clark

VLA Imaging at 74 MHz

The VLA has been fully equipped at 74 MHz (4-band) since late January. In response to a general call for proposals made in anticipation of this completed system, about 20 proposals, totaling over 200 hours observing, were accepted for scheduling during the current A configuration. This observing season will end in late March, and the dipole feeds removed.

Preliminary results of the data are very encouraging. The system sensitivity, although not spectacular by the standards set at higher frequency, are nevertheless far better than ever achieved at this frequency before. Figure 1 shows an image of the center of the Coma cluster with 25 arcseconds resolution and 20 mJy rms noise. This image is the result of approximately 7 hours' integration, with 26 antennas, one IF pair, and an IF bandwidth of about 1 MHz.

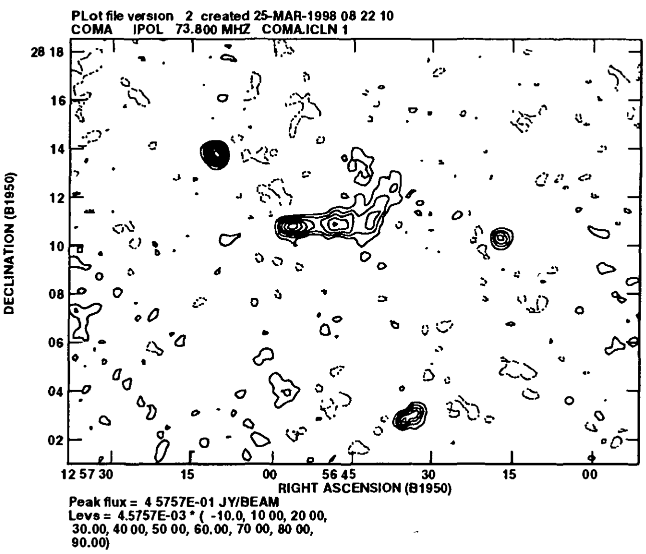
Image fidelity, as measured on very strong objects, is similar to that found at 327 MHz. Figure 2 shows the nearby radio galaxy Virgo A, with a dynamic range of well over 1000:1. This image was made with about 2 hours' data.

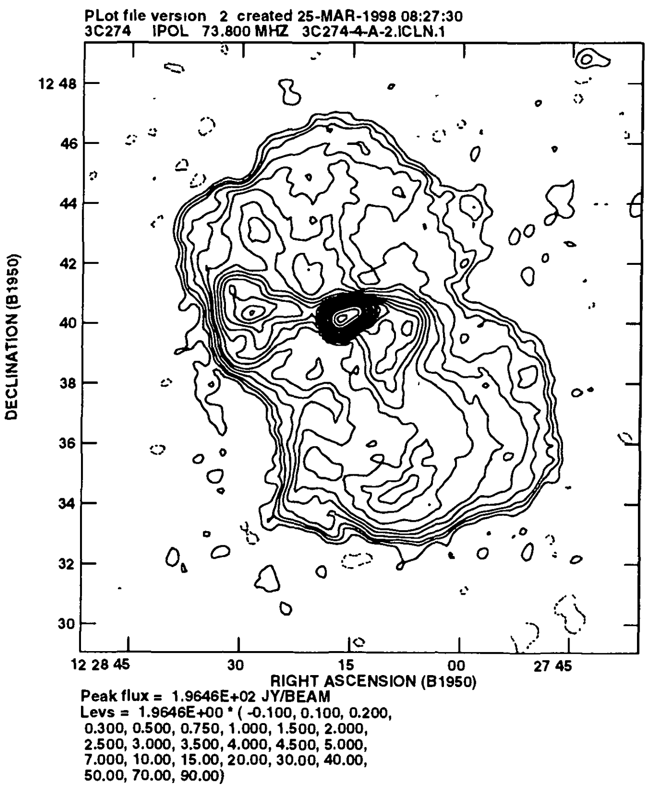
The problems associated with RFI have proven to be minor in this configuration. Nearly all interfering signals are locally generated, and are located at precise multiples of 100 kHz, making them easy to remove from the data.

Calibration has proven fairly straightforward, as the ionosphere has been in a relatively calm state. We find that phase calibration is reliable for objects which are relatively unresolved and unconfused and whose flux density exceeds 20 Jy. The angular coherence scale for phase transfer certainly exceeds 2 degrees, and may be as large as 5 degrees for the shorter baselines. Specific observing to measure this crucial quantity has been made.

For weak sources where ordinary self calibration cannot work, and which are too far from a phase calibrator, phase transfer calibration, using a 327 MHz image to estimate the required phase corrections, is expected to suffice. Tests of this method are now beginning.

R.A. Perley





Performance of the VLA at Low Frequencies in the L Band

The sensitivity of the L band receivers below 1250 MHz is currently being investigated to determine the feasibility of observing the HI 21 cm line at redshifts up to z=0.30, corresponding to a frequency of about 1090 MHz. This is a brief report on work in progress of which the first results are very promising. Figure 1 shows the RFI environment at the VLA site between 1080 and 1250 MHz. There is an 80 MHz wide window centered on 1190 MHz in which the RFI environment is quite benign. These frequencies are used by transponders carried by aircraft. Below 1150 MHz, the spectrum is polluted by air traffic radars and the spikes at 1230-1240 MHz are GPS signals.

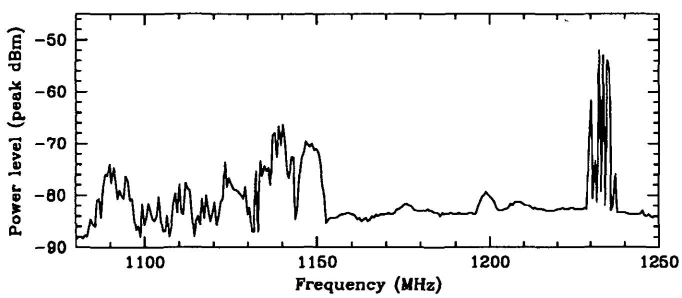
We probed this spectral range with the VLA-D to A array at 1217, 1187, 1167, 1137, 1117, and 1087 MHz. A reference observation was made at 1387 MHz to provide the nominal noise level. A 12.5 MHz IF filter was employed, and the total bandwidth was 6.25 MHz with 63 spectral channels. Two polarizations were received. At each frequency setting we integrated for three minutes on 3C286 and for ten minutes on a secondary calibrator of 0.7 Jy. Continuum subtracted data-cubes of the secondary calibrator were constructed and the noise was measured in the channel images.

The noise levels at 1217 and 1187 MHz were only about 50 percent above the noise at 1387 MHz. At 1167 MHz, the noise is roughly a factor of two higher than at 1387 MHz, and at 1137 MHz a factor of six higher. At 1117 and 1087 MHz most of the data were flagged by the on-line system due to excessive RFI and LO's lock problems. It should be noted that the measured noise levels were normalized by correcting for the missing flagged visibilities, the weighting of the UV data, and the different system temperatures due to the varying elevations of the observations. Also, seven antennas had poorly behaved bandpasses at the lowest frequencies and had to be flagged.

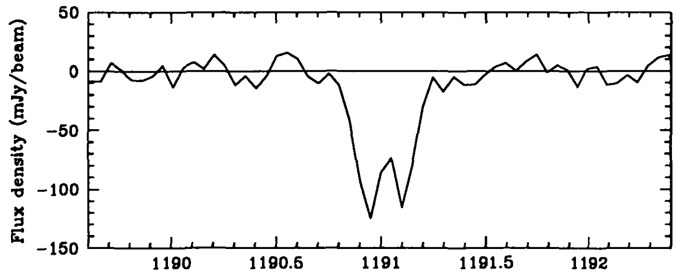
To demonstrate the performance of the VLA at these frequencies, we observed the known HI 21 cm absorption line toward the brightest "Einstein ring" radio source PKS1830-211 at 1191 MHz, corresponding to z=0.193. The result is shown in Figure 2. The detection is in accord with previous observations at Parkes and the Australia Telescope, and the noise in this spectrum is only 50 percent higher than would be expected at the center of the VLA L band.

Further investigation is underway to delineate the sensitivity below 1200 MHz with finer frequency coverage, and to understand the bandpass shape at low frequencies. From these initial tests it is clear that useful observations can be made with the VLA down to 1150 MHz, and proposals for use of the low frequency part of the L band are welcome.

M.A. Verheyen and C.L. Carilli



Typical RFI spectrum in the 1080-1250 MHz range provided by Dan Mertely, obtained on 4 Mar 1998, 19:06 MST. Plotted are peak values over a 1 minute interval. (See http://www.nrao.edu/vla/html/rfi.shtml)



HI absorption spectrum of PKS1830-211 obtained with the VLA-D>A array on 11 Feb 1998, 10:44 MST, using the 2AD mode, a 3.125 MHz bandwidth and on-line hanning smoothing. The integration time was 100 min.

Site Testing Interferometer

The VLA site testing interferometer (STIfR) has been operating since the fall of 1997. The STIfR is a device that measures the tropospheric contribution to the interferometric phase using an interferometer comprised of two 1.5 m dishes separated by 300 m observing an 11 GHz beacon from a geostationary satellite (Radford, Reiland, and Shillue 1996, PASP, 108, 441). The initial months of operation involved debugging problems with the stability of the electronics due to thermal variations and problems with the general STIfR infrastructure. These problems have been solved, and the interferometer has been working reliably since January 1998.

The data from the STIfR are meant to be used for real-time decision making by the user when observing with the VLA at high frequency. The data can be accessed via the NRAO home page, under:

http://www.nrao.edu/vla/html/PhaseMonitor/phasemon.html

The software requires an X-windows system for display of the current data. Data consist of the measured phase time series, from which is derived the root phase structure function, and a power-law fit is made to the structure function to quantify the seeing conditions. Also displayed are data from the VLA weather station. The web page has a series of help files providing equations for converting the STIfR standard data products into VLA observing requirements.

As an example, values for the standard data products from the STIfR on the cold, clear night of February 2, 1998, were: corner time = 30 second (the time for a parcel of atmosphere to cross the 300 m baseline), saturation rms phase = 4 degrees (the rms of phase fluctuations on time scales > 30 s), and power-law index of 0.7 (the phase fluctuation spectrum is a power law with power increasing towards longer time scales, up to the 30 s crossing time).

One can use equation 4 under the "How to Interpret Data from the STIfR" help-file on the web page to derive the required Fast Switching phase calibration cycle time for a particular experiment. For instance, for a 43 GHz observation in A array under the conditions cited above, a Fast Switching phase calibration cycle time of 130 second would result in residual rms phase variations of 20 degrees after calibration.

As a second example, during the day of February 19, 1998, the power-law index and corner time were the same as above, but the saturation rms phase was 15 degrees. In this case the required cycle time in order to reach 20 degrees rms phase residuals is 23 second. This cycle time is shorter than allowed by the current capabilities of the VLA (absolute minimum cycle time = 40 sec), and it would be recommended to switch to a back-up project at lower frequency, unless an rms phase noise larger than 20 degrees is acceptable or unless phase self-calibration is possible.

In a future revision, the residual phase errors to be expected for various calibration cycle times will be calculated from the measured seeing conditions and made available in real time, along with improved help, and cosmetic improvements to the displays. Suggestions on improvement of the system are welcome (contact ccarilli@nrao.edu or aroy@nrao.edu).

C. L. Carilli and A. Roy

1998 Synthesis Imaging Summer School

The Sixth Summer School in Synthesis Imaging will take place Wednesday, June 17 through Tuesday, June 23, 1998. The summer school will be hosted by NRAO and New Mexico Tech, and will be held in the new Workman Center on the Tech campus in Socorro, New Mexico. In addition to lectures covering all aspects of radio interferometry, data reduction tutorials on June 20 at the Array Operations Center (AOC) will allow attendees to get "hands-on" experience with data calibration and imaging for both VLA and VLBA data.

The timeline for the school is reproduced here. Further information, including the complete program can be found at http://www.nrao.edu/~gtaylor/synth98.html. Participants may register electronically from this web page before May 15.

Important Dates for the 1998 Synthesis Imaging Summer School

15 September 1997	First Announcement
1 February 1998	Early Registration Due
15 February 1998	Second Announcement
15 May 1998	Deadline for Registration
1 June 1998	Contributions Due from Lecturers
17 June 1998	First Day of School
20 June 1998	Data Reduction Tutorial at AOC
21 June 1998	VLA Tour
23 June 1998	Last Day of School

G.B. Taylor and C.L. Carilli

VLA Configuration Schedule

Configuration	Starting date	Ending date	Proposal Deadline
A	20 Feb 1998	01 Jun 1998	01 Oct 1997
BnA	12 Jun 1998	29 Jun 1998	02 Feb 1998
B	02 Jul 1998	19 Oct 1998	02 Feb 1998
CnB	30 Oct 1998	16 Nov 1998	01 Jun 1998
C	20 Nov 1998	01 Feb 1999	01 Jun 1998
DnC	12 Feb 1999	01 Mar 1999	01 Oct 1998
D	05 Mar 1999	01 Jun 1999	01 Oct 1998

The above schedule takes into account the increased length of time for the B array to accommodate the extension of the FIRST survey. To keep to a 16 month cycle through the configurations, C, D and A configurations will be shortened by one week below their normal durations.

The maximum antenna separations for the four VLA configurations are: A-36 km, B-11 km, C-3 km, D-1 km. The BnA, CnB, and DnC configurations are the hybrid configurations with the long north arm, which produce a round beam for southern sources (south of about -15 degrees declination) and extreme northern sources (north of about 80 degrees declination).

Approximate Long-Term Schedule

	Q1	Q2	Q3	Q4
1998	D,A	A	B	C
1999	D	D,A	A	B
2000	C	C,D	D	A
2001	B	B,C	C	D
2002	A	A,B	B	C

Observers should note that some types of observations are significantly more difficult in daytime than at nighttime. These include observations at 327 MHz (solar and other interference; disturbed ionosphere, especially at dawn), line observations at 18 and 21 cm (solar interference), polarization measurements at L band (uncertainty in ionospheric rotation measure), and observations at 2 cm and shorter wavelengths in B and A configurations (tropospheric phase variations, especially in summer). They should defer such observations for a configuration cycle to avoid such problems. In 1998, the B configuration daytime will be about 8^h RA and the C configuration daytime will be about 16^h RA.

Time will be allocated for the VLBA on intervals approximately corresponding to the VLA configurations, from those proposals in hand at the corresponding VLA proposal deadline. The VLBA spends about half of available observing time in coordinated observations with other networks, with the scheduling dictated by those networks. In decreasing order of the time devoted to the observations, these are: HALCA space VLBI, Combined Millimeter VLBI Array, Global astronomical VLBI with the EVN, and geodetic arrays coordinated by GSFC.

Any proposal requesting NRAO antennas and antennas from two or more institutions affiliated with the European VLBI network is a Global proposal, and must be sent to the EVN scheduler as well as to the NRAO. VLBA proposals requesting only one EVN antenna, or requesting unaffiliated antennas, are handled on a bilateral basis; the proposal should be sent both to NRAO and to the operating institution of the other antenna requested. Coordination of observations with non-NRAO antennas, other than members of the EVN and the DSN, is the responsibility of the proposer.

B.G. Clark

VLA Upgrade Status

Preparation of the Upgrade Design Document continues, with completion expected in June. This document will summarize all the proposed modifications to the VLA, along with estimates of the cost and implementation time scales, presuming funding availability. As many of the desired upgrade improvements are intimately linked to MMA development, many of these estimates will necessarily be approximations based on our current understanding of MMA developments.

Completion of the Design Document is tied to the design review meeting scheduled for June 29 and 30 in Socorro. This is an important meeting whose purpose is to permit the astronomical community to comment on our plans for the upgrade. All interested parties are invited to attend this meeting. If you wish to attend, please contact Terry Romero (tromero@nrao.edu) to register.

R.A. Perley and R.A. Sramek

New Mexico Computing Developments

During the fall of 1997, equipment was purchased to fully connect the outlying buildings at the VLA site (technical services building, warehouse, maintenance building, antenna barn and visitors' center) to our computer network. Previously, employees in these buildings have had to rely solely on dial-up access; this is no longer acceptable for their work. All of the inside wiring is now complete. Burying of the optical fiber between VLA buildings is currently in progress, and we expect the network to be fully functional by mid May.

It was discovered that for older (pre-1988) data and certain correlator modes (line data only), visibilities in the VLA archive have zero amplitudes and phases. About 20 percent of line data are affected. The bug in the conversion program that caused this has been fixed. The effects of this should be transparent to the user community: when faulty data are requested we will re-run the corrected conversion program on the old nine-track tapes before sending the data out. After finishing the re-archiving process later this year, we intend to redo all affected data and reinsert them in the existing archive. We are still in the process of assessing the time required to do this.

We have decided to replace the software that is presently being used to track VLA and VLBA module maintenance ("MAINT") with a commercial PC-based product. An RFP for such a system was sent to three vendors in early March. The bids have been received; we will invite the top vendor(s) to give presentations at the AOC during April and May. We expect final selection of the software to follow soon after. The Green Bank Telescope is also interested in using the new system to track their component maintenance.

In February 1998, we introduced a new way to run Windows applications on a UNIX workstation. While being displayed on the local UNIX workstations in an X-window, the Windows applications run natively on the remote hardware of a Windows NT 3.51/WinDD server with dual 200-MHz Pentium Pro CPUs and 128 MB of RAM. Using five concurrent user licenses, a number of Windows applications is available, such as MS Office 97 and Corel Suite 7.

G.A. van Moorsel

Migration of the Information System to the Web

In the early 1990s NRAO developed a simple menu-based information system for ASCII files covering Socorro, VLA, and VLBA topics. Portions of this information system, commonly known as VLAIS, have slowly been migrating to the Socorro, VLA, and VLBA home pages. In March, this migration was completed and telnet access to VLAIS from the home pages was disabled.

J.M. Wrobel, S.W. Witz, and M.P. Rupen

VLA Telephone Number Changes

The telephone numbers at the Very Large Array Telescope Site are scheduled to change on April 24, 1998.

- To reach the VLA Site (505) 835-7000.
- To reach the VLA Site Array Operators dial (505) 835-7180.

For a current telephone listing check the NRAO home page.

J P. Lagoyda

12 METER

New Digital Correlator for the 12 Meter Telescope

The construction on the new correlator for the 12 Meter Telescope continues. The 12 Meter correlator is identical to the Green Bank Telescope correlator in many respects and the experience gained in working on the GBT correlator is directly transferable. The main difference is in the samplers. The Tucson correlator will have only eight broadband samplers that make up two quadrants versus the four quadrants + narrowband samplers for the GBT correlator.

The following is a list of the modes that we are planning to support in the Tucson correlator:

Total Bandwidth	Usable BW/Chan	Lags/IF	Freq. Res/IF
-8 Active Samplers			
6.4 GHz	600 MHz	1024	0.781 MHz
3.2 GHz	300 MHz	2048	0.195 MHz
1.6 GHz	150 MHz	4096	48.83 kHz
0.8 GHz (.75)	75 MHz	8192	12.20 kHz
-4 Active Samplers			
3.2 GHz	600 MHz	2048	0.390 MHz
1.6 GHz	300 MHz	4096	0.097 MHz
0.8 GHz	150 MHz	8192	24.41 kHz
400. MHz	75 MHz	16384	6.10 kHz
-2 Active Samplers			
1.6 MHz	600 MHz	4096	0.195 MHz
0.8 GHz	300 MHz	8192	48.83 kHz
400. MHz	150 MHz	16384	12.20 kHz
200. MHz	75 MHz	32768	3.05 kHz

The software for the new spectrometer, developed by Jeff Hagen in Tucson, will be similar to that developed for the GBT correlator. We anticipate installation of this new system on the telescope during the 1998 summer shutdown period.

M. Waddel for the Tucson Electronics Group

Note to 12 Meter Observers — In order to make the best use of the telescope, prospective and scheduled observers are strongly encouraged to contact the Friend of the Telescope, Jeff Mangum, for advice regarding their proposed experiments. This is of particular importance for observers conducting 1mm Array and on-the-fly experiments given the complexity of these observing modes. Send questions via email to jmangum@nrao.edu or by voice to (520) 882-8250, ext.113.

J.G. Mangum and D T. Emerson

1 mm Array Receiver Status

The 8-beam 1 mm array receiver has been in routine use on the telescope since late January. The 4x2 beam cluster can map in both (RA,Dec) and (lII,bII) coordinates while tracking parallactic angle with an arbitrary position angle offset The current performance of the receiver represents a substantial gain over the existing dual-beam system for making maps of extended regions. During this past summer and fall work on this receiver concentrated on solving problems with servo stability and mixer system temperature uniformity. These efforts by the Tucson electronics group have resulted in vastly improved total power stability and good mixer system temperature uniformity across the eight receiver channels. We anticipate demand for this improved instrument to increase for the coming fall and winter quarters.

J.G. Mangum

Newsletter No. 75
1 April 1998

Greenwich	GMT	+0:00
Australia	EAST	-10:00
Netherlands	MET	-1:00
Charlottesville	EST	+5:00
Urbana-Champaign	CST	+6:00
Socorro	MST	+7:00

AIPS++ Newsletter

April 1998

AIPS++ is a project of the AIPS+ Consortium

JIVE Use of AIPS++

Huib Jan van Langevelde, Chris Phillips, Harro Verkouter - JIVE, Dwingeloo

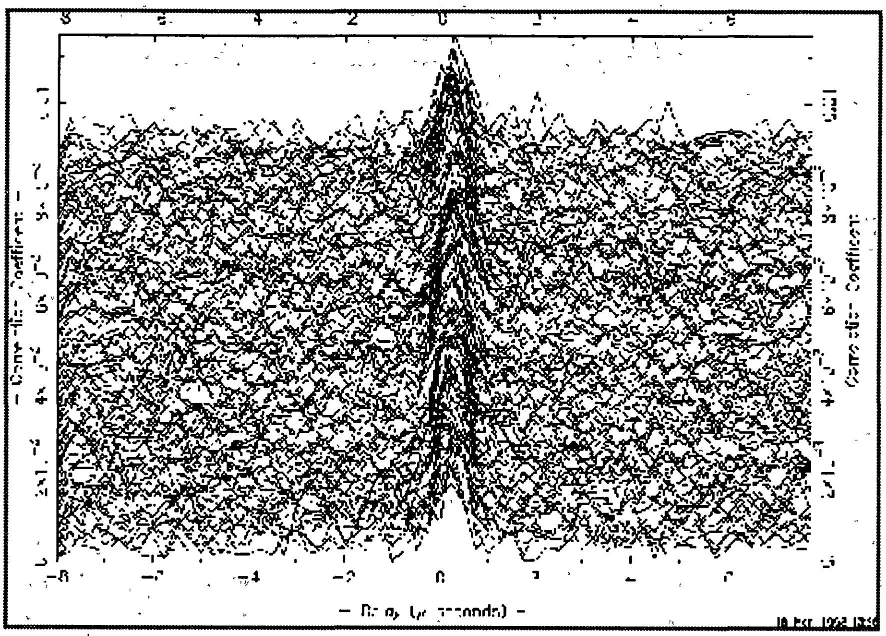
One of the main efforts at the Joint Institute for VLBI in Europe (JIVE) at Dwingeloo in the Netherlands is the construction of a 16 station MkIV data processor for the European VLBI Network (EVN). This correlator will process both European and global VLBI projects recorded in VLBA and MkIV format - with data-rates up to 1024 Mbit/s per station and 4096 spectral channels per baseline. The project is currently in a transition phase between construction and testing; first fringes were obtained in the Summer of 1997 and currently we are integrating hardware prototypes and software. A first imaging test, using the final hardware, is planned for the Summer of 1998.

It was decided to use AIPS++ as the platform for developing all post-processing software. This includes (pseudo) real-time display of results, data quality control, feedback to VLBI telescopes, preparation of calibration data, and formatting the product for the end user. For the latter it is assumed that most astronomical VLBI calibration initially will be carried out in "Classic" AIPS, and therefore users will need their data in `UVFITS` format.

One of the considerations in the decision to develop this "off-line" part of the software in AIPS++ is that we recognize it as the data reduction tool of the future. In particular, the idea that staff astronomers can work and program for the correlator with the same software they use for their scientific research is attractive; but the main consideration in streamlining the correlator output is speed. The expected data-rates are in the range of 50 kB/s to 3 MB/s. We decided to minimize any formatting or sorting operations in the output stage. We also wanted to avoid having to copy the raw data to another format for inspection. This seemed to rule out direct conversion to a standard format, or re-sorting the data for a specific package. AIPS++, on the other hand, offers an interesting capability by creating a special Storage Manager for the correlator output in its raw form.

At the moment we are still defining the correlator output format, ensuring that its content allows a direct mapping to an AIPS++ Measurement Set. This explains our interest in the current effort to come to an MS definition that is capable of completely describing VLBI measurements. As an important step in this project a "JIVE filler" was created that writes the current output data into an MS. This has proven a useful exercise not only to learn how to work in the AIPS++ software environment, but also to discover what data structures are required to create a proper data set.

Furthermore, it has given us a nice tool to inspect the data produced by the correlator prototype. We have had the capability to study the data with the standard AIPS++ tools from the day after first fringes on 22 July 1997. Using mainly *Glish* scripts for mathematical operations, and plotting, it is possible to analyze the correlator output in the testing stage.



(please click on image to obtain larger view)

A typical example of such an exercise is displayed in the above figure. Data from a recent test using two separate tapes, played back synchronously for the first time (the first fringes were obtained with two MERLIN stations recorded on a single tape), is displayed as a time series of correlation functions. The absolute value of the correlator response over 64 lags is given, with every two second integration slightly offset in amplitude from the previous one. The data were recorded (with the new MkIV formatters) in November 1997 and the baseline is between Effelsberg and Medicina. The bandwidth was 2 MHz, the observing band 5 GHz and the source 0016+731.

The data were filled into an AIPS++ Measurement Set which contained the output of 128 correlator chips (one eighth of the final capacity), each with 64 complex lags, integrated over 2 seconds. *Glish* scripts were used to select and display the data. The figure shows that with the dynamic control of the correlator implemented in the control software, we get a nice stable residual delay, which is only 250 nanoseconds from where it was expected. Another important measure in this figure is that the average correlation amplitude is approximately 0.002, which again is as expected.

Other simple diagnostics that are accessible with the standard AIPS++ tools are plots of the residual rate and comparison of the phase response of separate frequency bands. We have been able to quickly produce simple routines that, for example, compensate for the residual rate, average the data in time and Fourier transform to inspect the spectral response. The results can be compared with the autocorrelation spectra, which were also obtained by Fourier transforming the data.

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