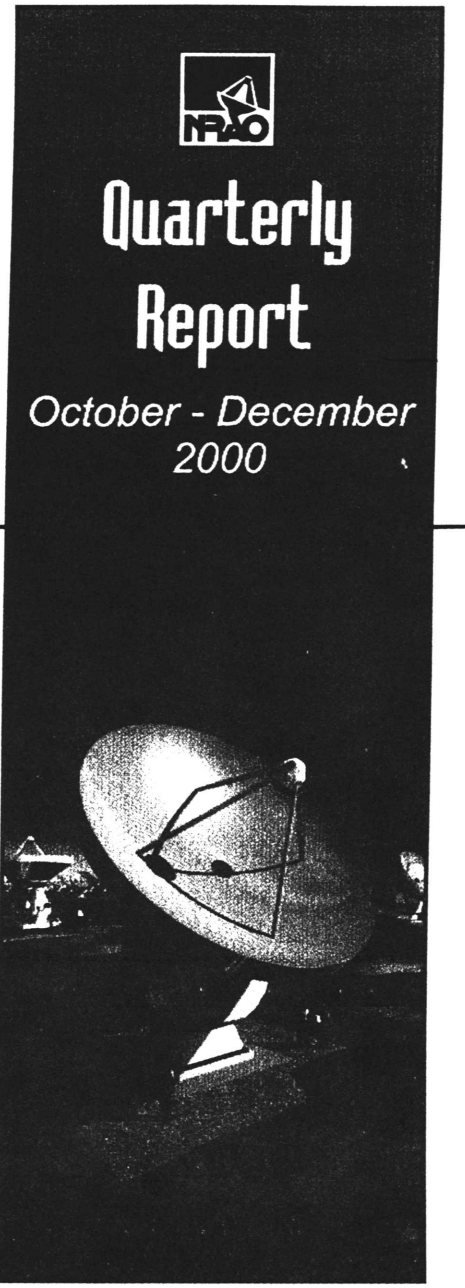

National Radio Astronomy Observatory

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SCIENCE HIGHLIGHTS

Green Bank Telescope

GBT Early Science Proposals - Eighty observing proposals involving 160 different scientists were received in response to the call for *Early Science* proposals on the Green Bank Telescope. This was a special call for proposals aimed at projects with the potential of significant scientific return, but which can be executed under "shared risk" conditions while telescope commissioning proceeds. The distribution of the received proposals by broad subject category was 23 galactic, 29 extragalactic, 23 pulsar, and 5 planetary. The proposals have been sent out for refereeing. The proposals contain many exciting ideas that will take advantage of the unique capabilities of the GBT. Further calls for proposals will occur during 2001.

Very Large Array

VLA Reveals Gas Flow in Barred Galaxy - Sensitive polarization observations with the VLA have shown that shocked gas in the barred galaxy NGC 1097 is diverted by nearly 90 degrees to flow directly down the bar toward the galaxy's nucleus. The polarization observations show the magnetic field orientation, which is a tracer of the gas velocity. The results are in general agreement with computer simulations, but show that the shock front where the diversion occurs is closer to the bar's center, not at its edge as the simulations suggest. In addition, the observed magnetic field near the center of the galaxy indicates that magnetic stress may serve as the mechanism for feeding the central black hole with the amount of material required to account for the observed activity.

Investigators: *R. Beck (MPIfR); M. Ehle (MPIfEP); A. Shukurov (Newcastle); and D. Sokoloff (Moscow State Univ.)*

Very Long Baseline Array

VLBA observations of the Galactic black hole binary GRS 1915+105 have revealed a compact synchrotron jet approximately 10 AU in length at the microquasar's core.-This jet, the first of its size imaged in any black-hole binary, is present continuously, reestablishing itself within eight hours of major radio outbursts. It increases in intensity approximately 30 minutes after dips in the core X-ray emission, suggesting that it is powered by injections of plasma from the accretion disk. The VLBA observations also show, at larger scales (approximately 500 AU), superluminal motions of ejecta from outbursts associated with abrupt changes in the X-ray emission. The VLBA observations of this microquasar take advantage of its status as a unique laboratory for studying both the plateau and the flare states seen separately in other black-hole binaries.

Investigators: *V. Dhawan (NRAO), I. F. Mirabel (CEA, Saclay), and L. Rodriguez (UNAM).*

MILLIMETER ARRAY PROJECT
(ALMA-U.S.)

The ALMA project continues to make progress toward the expected start of construction in October 2001. In addition to the major milestones listed in the table below, a number of very important programmatic and technical achievements occurred during this period. The milestones listed in the table are taken from the ALMA project WBS and represent the major milestones planned for completion during this quarter and the next.

WBS Element	Milestones	Original Deadline	Revised Deadline	Date Completed
1.05.25.15	ALMA Project Book: Joint Version	11/01/00	12/08/00	12/08/00
1.10.35.05	Deliver Management Plan For Construction	10/01/00		10/01/01
2.10.10.15	PDR: Site Development Plan	01/15/00	09/01/01	
2.10.10.25	Deliver revised site development plan	03/01/01		
3.10.05.40.15	Vertex Prototype antenna CDR	11/15/00		11/15/00
4.25.05	PDR: Front End Subsystem	11/01/00	02/16/01	
7.10.30	Deliver Test Correlator to ALMA Test Site	03/01/01	02/15/01	
8.03.30.25	CDR: Control Software	03/01/01		
10.17	CDR: ALMA Configurations	03/01/01	02/26/01	

The ALMA Project Book represents the current baseline definition and technical description of the entire ALMA project. The version completed during this period is the first complete description of the joint project as agreed to by the U.S. and European projects. This version, now under configuration control, provides the scope and detailed technical definition of all portions of the construction phase. Reaching agreement in many areas took considerable effort and caused a slight delay completing the effort.

The Management plan completed during this period defines the organizational structure for the bilateral project during the construction phase. The plan, presented to the ACC, is organized around Integrated Product Teams (IPTs). IPTs are an established method of organizing large projects where work is distributed among multiple organizations and locations. It is well suited to the challenges presented by the ALMA project.

The PDR for the Site Development Plan will be delayed because of delays in obtaining permissions in Chile for the ALMA project. The specific form of these permissions will have a major impact on the plans to be reviewed. The schedule for this PDR will be reviewed as the permissions issue is resolved.

A Revised Site Development Plan will be available before the planned deadline. As described above, issues related to the permissions for ALMA in Chile will likely require additional revisions to this plan after this version is released.

The Vertex Antenna PDR was held as scheduled. Members of the review panel included three expert outside reviewers from the BIMA, OVRO and SMA projects, three members of the ALMA-Europe antenna group, eight members of the ALMA-U.S. technical groups and three members of the ALMA-U.S. management group. The review went well with the contractor presenting analysis demonstrating that all performance specifications for the antenna will be achieved. No significant aspects of the design were found to be unacceptable. A list of issues arising from the review was transmitted to Vertex; these issues were primarily requests for further information or additional supporting calculations.

A PDR for the Front-End Subsystem is now scheduled for February 26, 2001. This PDR was delayed to provide additional time to resolve a number of questions relating primarily to the design of the optics. These issues were resolved at an optics workshop held in October. A complete Front-End Requirements Document has been completed and forms the basis for the review in February.

The Test Correlator will be used for the Test Interferometer. The correlator and its software are complete and ready to ship from the CDL in Charlottesville to Socorro.

The CDR for the ALMA configurations will be held in Grenoble on February 26, 2001. Modeling results of two competing configuration designs will be compared and a single baseline configuration design will be selected.

Other Significant Accomplishments

Programmatic

At the meeting of the ALMA Coordinating Committee (ACC) on October 13, 2000, in Paris, Mr. Takayoshi Seiki, Director of the Research Institutes Division of the Japanese Ministry of Education, Science, Sports and Culture was invited to address the ACC. Mr. Seiki distributed a prepared statement in which he formally records the interest of Monbusho in being a third, equal, partner in the ALMA Project. His statement that Monbusho will use its best efforts to secure funding for ALMA is identical to the status of the commitments made so far by the U.S. and Europeans.

The ACC drafted a response which makes the following points: 1) It warmly welcomes Mr. Seiki's statement; 2) It affirms the desire of the American and European partners to work with Japan in common pursuit of a successful ALMA Project; and 3) It sets up a process tying confirmation of the tripartite project to an expansion of the ACC that will include members from Japan.

The ALMA Executive Committee (AEC) established, and is implementing, a configuration control plan. The plan specifies the procedure for baselining and controlling changes to project documents. The Project Book is the first document to come under configuration control.

Technical

The design was completed for the data transmission protocol of the fiber optic link that carries information from each antenna. Detailed design of the embedded logic to implement the protocol is already under way.

A Critical Design Review for the holography system was held in Tucson. Holographic measurements of the prototype antennas panel surface accuracy will be the primary means of demonstrating compliance with contract specifications.

Site development has started at the VLA site in preparation for delivery of the prototype antennas in the fall of 2001. Power distribution and trenching for fiber optic cables between the antennas and control building has started. Foundations for the antennas will be started early in 2001.

A prototype helium compressor has been completed and tested in Tucson. The prototype, intended for use with the Test Interferometer, meets all of the requirements for operation in Chile. It is designed and has been tested for use with both 60 Hz and 50 Hz power, is operated via the ALMA standard monitor and control bus, and is has sufficient capacity for operations at 5000 m.

A test of the control software to be used with the Test Interferometer was successfully completed using the 12 Meter Telescope at Kitt Peak. Use of the 12 Meter was coordinated with the University of Arizona which is operating the facility under a loan agreement. These tests are a very useful means of minimizing schedule risk during software integration when the antennas are delivered in the fall of 2001.

Significant progress has been made in the development of the baseline correlator for the ALMA array. The design of the custom correlator chip has been completed. This design is being extensively tested using simulation software by the vendor and at the CDL. An initial procurement of prototype quantities of the chip will likely occur early in 2001. Additionally, fabrication of a prototype FIR Filter board for the correlator was completed. This board was designed by the CDL and uses high density surface mount chips. The prototype was fabricated at the Tucson Labs. Tests demonstrate that there were no errors in the artwork design, and the surface mount fabrication flawless. This is an important verification of the process that will be used for the remaining boards of the correlator.

During this quarter, twenty new ALMA Memos were added to the series bringing the total number to 342. The ALMA Memo Series is available at http://www.nrao.edu/almamirror/memos/.

GREEN BANK TELESCOPE

Outfitting

Milestone	Original Date	Revised Date	Date Completed
Complete ACR outfitting	06-01-00	11-30-00	11-30-00
Measure X & Ku feeds	07-03-00	12-15-00	12-15-00
Measure K-band feeds	07-03-00	01-29-00	
Terminate optical fibers	07-28-00	12-01-00	12-01-00
Install weather station 2	08-18-00	11-22-00	11-22-00
Install feedarm lasers	09-15-00	03-30-01	
Install low freq. receivers	09-30-00	11-28-00	11-28-00
Install high freq. receivers	09-30-00	11-27-00	11-27-00
Install perimeter fence	11-17-00	01-31-01	
Measure az track profile	09-15-99	03-30-01	

GBT Electronics Development

Milestone	Original Date	Revised Date	Date Completed
Holography Gregorian Feed Construction			12-01-00
Q-Band Receiver available for use	12-31-00	3-31-00	
Active Surface / M&C integration & testing	02-28-01		
GBT new compressors & cryo system	07-14-00	03-31-01	

Mechanical Engineering and NRAO Central Machine Shop

Milestone	Original Date	Revised Date	Date Completed
Fabricate GBT RFI door closures	11-02-00		11-02-00
Fab. mounts for GBT laser cable tray	11-20-00		11-20-00
Fab. GBT S-Band Receiver support	10-10-00		10-10-00
Install GBT spillover shield	01-24-01		
Install GBT holography reference horn	02-07-01		
Fab. GBT tachometer covers	02-28-01		
Fab. mount for GBT optical guide telescope	02-28-01		

GBT Software and Computing

Milestone	Original Date	Revised Date	Date Completed
Release M&C Version 3.1.2	08-25-00	11-09-00	11-09-00
Order GBT Data Handling System	10-01-00	12-22-00	12-22-00
Release M&C Version 3.2.0	01-12-01	01-19-01	
Complete antenna servo tests	01-19-01		
Spectrometer basic spectral line modes available	03-16-01		
M&C / VLBA software integration	01-19-01	04-01-01	
Observer (GO) interface completion	03-23-01		
Optical pointing telescope development and installation	02-02-01	03-01-01	

GBT Operations

Milestone	Original Date	Revised Date	Date Completed
Operations training on initial GBT systems	12-15-00		12-15-00
Operator training on most essential GBT systems	03-31-01		
GBT proposal processing software (v. 1)	12-30-00		12-30-00
Commence GBT Programmed Maintenance	01-30-01		
Operations of GBT from GBT Servo Room	02-01-01		
Operations documentation templates available	03-01-01		

GBT Project Summary

The major activities at the GBT during the last three months have included the outfitting of the telescope with NRAO equipment, the continuing completion of punchlist items, the alignment and testing of the elevation bullgear, and the repair and testing of the azimuth track.

Telescope Outfitting

The installation of NRAO equipment in the servo and receiver rooms is essentially complete. All electronics racks (prime focus, motor, LO, IF, and fiber interface) and the L-, S-, C-, X-, Ku-, and K-band receivers were installed in the receiver room. The prime focus receiver with its 800 MHz feed was also installed. Interconnecting coaxial cables were routed between the racks and receivers. All six sets of cryogenic lines were pressure tested, and the evacuation and cold-trapping of the lines is nearing completion. The prime focus, C-band, and L-band receivers were cooled down. Servo racks and the servo UPS were installed in the servo room. Connectors were installed and splices were made on the optical fibers that run between the receiver room and servo room. Monitor and control bus (MCB) cables were connected to equipment in the receiver room so that the operation of the equipment could be checked with monitor and control (M&C) software. The simulated pointing observations that were conducted in the mockup with the M&C software were resumed on November 10.

The outfitting of the actuator control room (ACR) is complete. The power supplies for the surface actuator motors and the actuator transnet system were installed in the ACR. Computer timing and ethernet signals were routed and connected to the ACR. Readings from the actuator position indicators were recorded in preparation for an additional setting of the reflector surface.

Portions of the asphalt road leading to the GBT site warehouse were removed in preparation for the installation of a fence around the GBT, which is needed for safety reasons when the ground laser rangefinders are in operation. The fence should be installed by the end of January 2001.

Progress on Punchlist Items

Lockheed-Martin completed the optical alignment of the subreflector, receiver room, and prime focus boom. The Kollmorgen motors that position the subreflector and prime focus boom were then returned to the manufacturer for repairs. The repaired motors were installed in November.

The servo and optical alignment sections of the GBT Final Acceptance Test Procedure were completed and accepted on November 29. The sections in the test procedure that remain to be completed are HVAC, hoists and manlifts, electrical, and the primary reflector structure, which includes the elevation bullgear.

The finite element model of the GBT showed that two structural members in the box structure can become over-stressed in one of the more severe design loads for the telescope (ice on the structure). Lockheed-Martin proposed, and NRAO agreed to, a modification to the members that halves their effective length, and thereby increases their allowable stress by a factor of two.

Lockheed-Martin and NRAO finalized plans for the replacement of the nine azimuth wheel bearings that showed significant rust and pitting. Lockheed-Martin will purchase nine new bearings, and a subcontractor will replace seven of the bearings during the month of May 2001. NRAO determined that the two remaining bearings can still be used and will replace them at a future date if necessary. NRAO will also implement an aggressive grease inspection program to insure that all bearings remain in good condition. Since the azimuth wheel trucks will be elevated on hydraulic jacks, the telescope cannot be moved during the bearing replacement procedure.

Elevation Bullgear

Lockheed-Martin completed the alignment of the segments in the elevation bullgear. Once the alignment was complete, the segments were secured in place by reinforcing the segment joints and by welding metal stops on either end of the assembled gear to press the individual segments together. Unlike previous tests, experiments conducted in December indicate that the segments do not move under routine operational loads. However, one test showed that a segment moves slightly (by about 0.005 inches) when large forces are applied. This suggests that additional reinforcement of the segments may be necessary.

Azimuth Track

An inspection of the azimuth track revealed that many of the bolts which secure the track wear strips to the track base plates had broken. This problem was initially attributed to the inferior quality of the low strength bolts that had been installed in the track. But after Lockheed-Martin replaced the original bolts with high strength bolts, the wear strips moved circumferentially as the azimuth wheels rolled over them. Additional tests have shown that the track wear strips and baseplates move in the direction of telescope motion. A single wear strip can move by as much as one-eighth of an inch. Lockheed-Martin will attempt to prevent the motion of the track by attaching as many as four consecutive sections of the track. When these track modifications are completed in mid January, the tests of the azimuth track will be repeated.

Recognizing that problems with the bullgear and azimuth track will delay GBT pointing observations, a number of tasks were identified and scheduled to allow the commissioning of the telescope to proceed. These tasks do not require the telescope to point, and include RFI surveys, frequency checks, tests of IF amplitude stability, and spectral baseline checks. Pointing observations will likely commence in late January 2001.

Project Budget (as of November 30, 2000)

The GBT project budget was effectively closed in December. The last major purchase in the project was made on December 20 for a data handling workstation and an array of data storage disks. All project consulting agreements have been closed. The major outstanding item for the project budget is an invoice for the installation of the conduit and cable tray to the lasers on the lower feedarm. Lockheed-Martin will submit the invoice in early January 2001. No additional charges will be made to the project.

GBT Project Budget

Category	Allocation ($k)	Expended ($k)	Balance ($k)
Antenna	9	0	9
Electronics	30	35	(5)
Surface / Pointing	74	56	18
Monitor / Control	56	0	56
Project Management	153	153	0
Total	322	244	78

GBT Electronics Development

GBT Spectrometer

Spectrometer software development continued in the fourth quarter. The development priorities are the basic modes of operation identified in the GBT science workshop report. Testing will continue throughout January. Enhancements to the system to allow better isolation of faults and integration of software have been designed. One such modification will equip all long term accumulators with LEDs to indicate the status of various key bits on the cards. Another modification will buffer key signals on the VME interface board and bring them out to front panel test points for easy access with a logic analyzer or oscilloscope. These modifications were completed in the fourth quarter. The PLL on the 100 MHz clock has been tuned to reduce spurious components of the sampling clock. The 1600 MHz PLL will be tuned next.

Other GBT Back-ends

The Spectral Processor was used this quarter for debugging and RFI measurements, and is ready for general use as a GBT back-end. The Digital Continuum Receiver has also been in regular use in the GBT Mockup to test receivers and other equipment for gain stability, temperature stability, etc., and is ready for general use. Work on integrating the GBT VLBA terminal is in progress and will be completed in the second quarter of 2001.

Holography Receiver

It has been decided that we wish to do holography from the Gregorian focus, as well as from the prime focus. A Gregorian feed was designed, fabricated, and tested. The system has been installed on the telescope.

GBT Active Surface

The Active Surface software is essentially complete. Some work remains in the interface between the Active Surface and the Metrology systems to allow calibration of the actuator using rangefinder data. System integration and testing should be completed in the first quarter of 2001.

Q-Band Receiver

Testing and characterization of this receiver has been done over the last quarter. Some additional testing and optimization will continue over the next quarter.

GBT Cryogenics

Installation and commissioning of the cryogenics system at the GBT continues. All lines have been cold-trapped. Several receivers have been cooled.

GBT Computing and Software Development

Monitor and Control

This quarter saw the complete outfitting of the GBT, and the start of commissioning. In preparation for this, we made two changes to the mechanisms for releasing monitor and control installations. Firstly, we created a new GBT installation, retaining the current mockup installation to allow background software testing in parallel with commissioning. Secondly, we have become more formal about releasing new versions of the M&C software. Releases take the form 3.n.m, where the "n" is incremented to reflect the release of new functionality (e.g. 3.2.1 will contain the Measurements Manager) and the "m" refers to incremental bug-fixes. 3.1.2 was installed as the initial GBT version of the software in November. With each new release, we freeze the previous version, to ensure we always have a stable version to fall back to if necessary.

The full installation of all equipment on the telescope revealed two further limitations of the single-board computers, both of which have now been cured. Firstly, running Managers for all seven receivers simultaneously caused the single-board computer gbtaio1 to run out of CPU cycles. This was tracked down to some poor implementation decisions in the MCB driver. Secondly, gbteio1 was locking up due to memory fragmentation and exhaustion, caused by making GUI connections to many Managers simultaneously. This was cured by installing a second single-board computer, gbteio2, and dividing the Managers between them. Numerous other bug-fixes and minor enhancements continue to be made. The problem with the generation of antenna trajectories for small steps has been identified.

Major progress has been made on the Manager for the GBT Spectrometer, and the first version (supporting spectral line observations) is largely complete. The major efforts included debugging the DMA routines to ensure reliable operation; implementing the de-scrambling of the lags in a generic way for all modes, and implementing the FITS file writing class. All of these have been tested in simulation, and are now ready for testing with the real hardware.

Other GBT Computing

As commissioning approached it became clear that, although agreed in principle, many aspects of the interface between the GBT M&C system, and the AIPS++ data reduction package remained to be specified in detail. The major areas were the precise format of the GBT engineering FITS files, the required operations of the GBT filler, and the initial stages of data reduction. Extensive discussions with the AIPS++ group were held to address these issues, and work started on documenting the critical areas.

The Proposal Submission Tool was completed and released in time for the initial call for Early Science proposals, issued on October 1. A number of comments (both positive and negative) were received, and these will be addressed in the next release. In the end, 80 proposals were submitted using the PST, and (at least from the GBT perspective) the process went rather smoothly.

The GBT back-end computer and RAID array was specified and ordered.

Computing Staffing

Richard Prestage has now taken over from Gareth Hunt as Head of the Green Bank Computing Division. Also, Arno Granados resigned from NRAO effective October 13, and was replaced by Anthony (Toney) Minter on November 20. We would like to thank both Gareth and Arno for their efforts on behalf of the GBT, and welcome Toney to the group.

GBT Operations Summary

GBT Operations Documentation

Development of operational procedures continued in last quarter of 2000 and will continue through the commissioning and early operational phases in 2001.

Operations evaluation of the final version of the COMSAT documentation for completeness began during the last quarter of 2000. Continued evaluation and incorporation into the GBT documentation system will continue in the first quarter of 2001.

Documentation for mechanical familiarization and antenna control continued during the last quarter of 2000. Effort in this area will continue through all of 2001.

Guidelines for maintaining and updating Operations documentation and for the use of Frontpage and RoboHelp in this effort were established in the last quarter. Frontpage templates were also designed to help in the maintenance of Operations documentation. Further fine tuning of the templates and guidelines will continue in the first quarter of 2001.

GBT Maintenance

A lubrication schedule log was developed. Some maintenance procedures were developed in the last quarter. Documentation of these procedures and development of more maintenance procedures will continue in the first quarter of 2001 and later. About one half of a years supply of lubricants and greases needed for GBT mechanical maintenance were purchased in the fourth quarter of 2000. More expendable supplies will be purchased during the first quarter of 2001 or as needed.

Due to personnel limitations the effort to begin the investigation of a contract for structural inspections was not started. This effort will be started in the first or second quarter of 2001 as resources become available.

Experience and training were completed during the last quarter in (a) the installation and removal prime focus receivers, (b) the installation of the Gregorian receivers, and (c) the installation and removal of feeds. Some mechanical preventative maintenance tasks will be started during the first quarter of 2001.

GBT Maintenance Work Order and Database System

Work on a detailed plan for implementation of the MainSaver software (for work order processing and PM planning) continued during the last quarter of 2000. The preliminary version will be completed during the first quarter of 2001. A decision was made to purchase the commercial Sybase Client/Server database software for Green Bank. This will be used in a number of different applications and, in particular, with the MainSaver software. Although this decision slowed the effort of installing the MainSaver server software, both the hardware and a significant portion of the requisite software needed to run MainSaver has been installed. This will be completed during the first quarter of 2001.

GBT Operator Training

Training on the GBT electrical system was completed by the end of 2000. Extensive training on the GBT control and servo systems was started in the last quarter and will continue into the first quarter of 2001. Training on the cryogenic and mechanical systems will begin when resources are available, possibly as early as the first quarter of 2001. Operators were trained in the operation of the GBT man lifts during the last quarter. Training on the upper elevator and in the operation of other mechanical equipment will continue during the first quarter of 2001. Safety training (in lock out/tag out, etc.) continued during the last quarter and will continue as procedures are finalized.

GBT Operations

With the turnover of the GBT to NRAO at the end of September, the Operations Group has manned a desk at the GBT warehouse and has coordinated all of NRAO activity on the GBT structure. Maintaining an operator presence in the warehouse will continue as needed and until control and operation of the telescope occurs from the Jansky Lab. During the very earliest stages of commissioning, operators will operate the telescope from the servo room on the GBT and then move control to the Jansky Lab as soon as is practical in the first quarter.

GBT operations personnel continued assisting in various outfitting activities throughout the last quarter of 2000. Some assistance will continue into the first quarter of 2001. GBT operators took over the operation of the lower GBT man lift at the end of the last quarter. They will continue in this capacity during 2001 until enough NRAO personnel are trained in the operations of the lower and upper GBT man lifts. During the last quarter of 2000, the operations personnel assisted in the elevation gear tests and RFI tests of GBT hardware. This assistance will continue during the first quarter of 2001.

A version of the GBT operator logging program specifications was started during the last quarter of 2000. The preliminary version will be completed during the first quarter of 2001. Some software to handle the first stages of GBT proposal processing was designed and implemented during the last quarter. Further development will continue into the first quarter of 2001 and later.

GREEN BANK SITE ENGINEERING, OPERATIONS, AND PROJECTS

Mechanical Engineering and NRAO Central Machine Shop

Milestone	Original Date	Revised Date	Date Completed
Fab. ALMA laser test source box	01-12-01		
Fab. 10, 100 GHz MMIC bodies for Central Dev. Lab	02-28-01		

Astronomy Education Center Project

Milestone	Original Date	Revised Date	Date Completed
Catching the Wave exhibit concepts completed	09-01-00		12-01-00
Complete architectural detailed design	12-14-00	02-01-01	
Design Review w/ NASA	01-04-01	02-15-01	
Pre-bid contractor conference	01-25-01	03-09-01	

Engineering

OVLBI Tracking Station

This quarter we completed a number of repairs to the OVLBI tracking station. Test equipment for troubleshooting the station was defined and some was purchased. This will help in increasing the station's reliability record, and reduce time to repair. Plans for the next quarter are to work on increasing reliability and decreasing the time to repair the station. This process is helped along by the increasing experience of the OVLBI engineering and technician staff.

General Site Support

Engineering support was provided to the Astronomy Education Center project for RFI suppression issues. Engineering was supplied to the Interference Protection Group for an RFI monitoring station. RFI testing of equipment was conducted.

Computing

Progress has slowly but surely continued on the installation and termination of the fibers in the Jansky lab. This has had to take second priority after the GBT outfitting, but is now close to complete. The new Ethernet fiber switch has been installed in the Jansky Addition. We hope work can start on the residence hall in the first quarter 2001.

Two new Windows NT Servers have been added to the NRAO Fiscal Division. One is a dual Pentium III with RAID level 5 hard disks and 512MB of RAM running Windows NT Server Terminal Server Edition with Citrix Metaframe installed on top of that. The terminal services of this server are used to improve performance for fiscal users from our other sites that are running either the ADP or HR Perspective applications. The 2nd Windows NT Server was installed for the purpose of providing access to the *e-time* application. The server has been up and running flawlessly and the necessary applications have been installed.

We have installed a Sybase database on the maintenance database (MainSaver) server. This server is not yet ready for production use, but we expect to have it available initially for accessing MainSaver in early January 2001.

We have acquired a number of racks for the planned move of all server class machines to the shielded area of the Jansky addition. This move should be performed in the first quarter of 2001. The new AS400 (main NRAO MIS computer) has been delivered, and will also be installed in this area.

We have completed the outfitting of the GBT operations room with a range of Linux, Solaris and NT workstations for both the operators and the commissioning team / visiting observers. This has included a pair of Linux PCs with dual graphics cards. We have purchased a second 6-tape DDS-3 auto-loader to streamline backup operations, and a new HP4050 printer to replace the aging QMS1275 in the Jansky lab.

After careful deliberation, we have ordered a Sun Enterprise 450 server with two StorEdge A1000 hardware RAID arrays to form the core of the GBT data handling system.

Operations - Other Telescopes

USNO 20 Meter, GBI, 85-3, and OVLBI Tracking Station

The USNO support for the operation of the 20 Meter telescope ceased on 30 September 2000. The 20 Meter will be moth-balled after it is used for VLBI tests supporting the GBT.

Operation of the Green Bank Interferometer (GBI) ceased during the last quarter of 2000 due to insufficient operating funds. The two telescopes and the electronics systems comprising the GBI will be mothballed during the second quarter of 2001. The telescope 85-3 continued its pulsar monitoring program.

The 45 Foot HALCA (OVLBI) tracking station continued operation during the last quarter of 2000 under contract with NASA. Reduced funding for 2001 coupled with increased pressure of fewer tracking stations will reduce reliability of this operation during all of 2001.

Education and Public Outreach

Green Bank Astronomy Education Center

The Green Bank Astronomy Education Center is a joint NSF and NASA funded project to construct a state-of-the-art education and visitor center. Exhibits are being developed via an NSF Informal Education grant, entitled "Catching the Wave." The building, an approximately 20,000 square-foot facility, will house a large exhibit hall, an auditorium, classrooms, a computer lab, an observing deck, as well as gift and café areas. The facility will serve the dual purpose of a visitor facility for the general public and an education center for K-16 programs. Green Bank already has a very active education program, and this facility will allow both the quantity and quality of those programs to be significantly enhanced.

The exhibit concepts were completed and documented on December 1. Exhibit construction is now proceeding. The architectural design is in its final stages and will be ready for contractor bids in early 2001. We are currently about two months behind the original building schedule owing to design considerations for improved RFI shielding and an expansion of the floor plan resulting from anticipated additional funds during 2001.

VERY LARGE ARRAY AND VERY LONG BASELINE ARRAY

Electronics

Milestone	Original Date	Revised Date	Date Completed
Preventive			
Assist with overhaul of two VLA antennas.	10-01-00		12-01-00
Xilinx controller to be reprogrammed to correct timing problem with error clock in correlator.	01-01-01	03-01-01	
Implement improved tape path calibration procedure.			12-01-00
Investigate six VLA site and two VLBA site radio frequency interference reports.	10-01-00		12-01-00
Process 28 military commercial frequency coordination requests, in part the result of three schedules sent to military frequency coordinators around the country each month.	10-01-00		12-01-00
Notify nine scheduled VLA and VLBA observers of likely radio frequency interference (RFI) during their observations in third quarter.	10-01-00		12-01-00
Projects			
• *VLA-VLBA-Pie Town Link*			
Decide next steps for link, i.e., development of improved round trip phase measurement, operation of the link using single fiber.	01-01-01	03-31-01	
• *New Receivers*			
Install six additional Q-band (7mm) receivers at VLA.	10-00-01	01-01-01	
Install solar calibration amplifier on VLA Q Band receiver.	01-01-01	03-31-01	
Install five K-band receiver (18-26.5 GHz) installed at VLA, bringing total to 16.			12-01-00
Assemble two W-band (3 mm) receivers and install one; this provided five operational receivers for CMVA run.	10-01-00		12-01-00
Test Y-coupler with new CDL amplifiers (reduced T_{sys} and insertion loss dramatically.			12-01-00
Complete installation of sixth W-band receiver.	01-01-01	01-01-01	
• *Upgrade for Pulsar High Time Resolution Processor (HTRP)*			
Construct Fast Analog to Digital Converter (FADC) assembly.	01-01-01	03-01-01	
VLA			
Extend existing 200 MHz VLA IF to 300 MHz by means of wider front-end filters.			12-01-00
Improve alarm reporting by the "wyecom" alarm system and plan replacement.	01-01-01	03-01-01	
K-band Water Vapor Radiometer (WVR)			
Lab-based tests of 3-channel WVR show Allen variance of < 1 part in 10^4 in signal over 1000 seconds, considered acceptable.			12-01-00
VLBA Panel Adjustments			
Prototype system to measure panel errors using microwave holography.	01-01-01	02-01-01	
Demonstrate holography at VLBA-PT.			12-01-00

Milestone	Original Date	Revised Date	Date Completed
High Density Recording Rates			
Complete expansion of formatter to permit recording rates of 512 Mbps at eight VLBA sites and VLA.			12-01-00
Interference Monitoring			
Place in operation: Military surplus RF monitoring system (VLA Environmental Monitoring Station (EMS); provided monitoring data for L-band on web.			12-01-00

Engineering

Milestone	Original Date	Revised Date	Date Completed
Complete Array reconfiguration to the A-array.	10-20-00		10-12-00
Complete overhaul of Antenna 2.	10-30-00	11-30-00	11-30-00
Overhaul Antenna 5 (Antenna 5's subreflector mount (FRM) will be removed and repaired in this overhaul period).	01-15-01	01-24-01	
Replace VLBA-LA Drive AZ #2 wheel bearing.	10-31-00		10-31-00
Replace VLBA -LA Drive #2 wheel assembly.	12-11-00		12-11-00
Complete VLA Antenna Dish panel adjustments to K-band (22-24 GHZ) holographic measurements.	12-29-00		11-30-00
Replace Los Alamos elevation bearing.	01-12-01		
Complete B-Array reconfiguration.	02-23-01		
Mechanical Group			
Complete VLA Apex handrail installations.	12-29-00		12-15-00
Install K-band feeds on Antennas 1 and 2.	12-01-00		12-01-00
Complete painting on Antenna 6, bringing the total to three painted antennas for this year.	10-31-00		10-31-00
Finish Transporter Vickers hydraulic pump tester on eight pumps (three required on each transporter); five tested acceptable.	12-01-00		12-01-00
Install Q-band receiver on VLA Antenna 9.	01-30-01		
Begin installation of VLA Fall Arrest.	01-22-01		
Test transporter limp pump system and modify transporter to limp over the roughest sections of the track.	03-01-01		
Assemble one spare VLBA wheel assembly.	03-30-01		
Electrical Group			
Identify Microchips in the VLBA ACUs having expired internal batteries; procure new chips and send to sites for replacement.	12-29-00		12-29-00
Complete final VLBA HVAC documentation and schematics.	09-01-00	12-31-00	12-29-00
Install HVAC and plumbing systems in preparation for ALMA office space.	03-30-01		
Complete energy saving modification to Control Building water tower pump lube system.	10-31-00	12-29-00	12-29-00
Install lighting, conduit, outlets and circuit breakers in CB Annex for ALMA office space.	12-29-00		12-29-00

Milestone	Original Date	Revised Date	Date Completed
Complete minor HVAC component changes at Kitt Peak VLBA.	03-30-01		
Site & Wye Group			
Finish five ALMA CB Annex offices and VSQ repair work.	11-30-00	12-29-00	12-29-00
Finish VSQ repair work.	11-30-00		11-30-00
Pour concrete pads - electrical units at the ALMA Test Site.	12-29-00		12-29-00
Clean & dress track embankment in the center wye through D9 on the east and north arms and to C7 on the west arm.	01-31-01		
Build and replace deteriorated antenna station fence corner braces.	01-31-01		
Complete waveguide LPS repairs.	03-30-01	02-28-01	
VLBA shop roof repairs.	03-30-01		
Complete earthwork for ALMA Test Site.	01-31-01		
ES Engineering Group			
Fabricate three Q-band feed mount gimbals (#23-25).	12-29-00		12-29-00
Fabricate W-band parts such as bias covers and snout shipping covers.	12-29-00		12-29-00
Machine K-band phase shifters.	12-29-00		12-29-00
VLBA and VLA HVAC schematic updating.	12-29-00		12-21-00
Build optical telescope for measuring antenna-pointing efficiency and pinpointing causes of pointing errors.	01-31-01		
Design VLA-VLBA Antenna quad leg fall arrest design.	09-30-00	12-08-00	12-08-00
Replace structural modeling and analysis of Los Alamos el bearing.	01-04-01		
Prepare work for fabrication of ALMA bins and modules.	01-31-01		
VLA visitor center roof repair.	02-10-01		
Machine four W-band Long Cal couplers.	12-20-00	02-25-01	
Machine five K-band F14 modules.	01-18-01		
Machine K-band Phase Shifter Mandrels.	01-29-01		
Communication between HP calculator and STV Optical telescope for data logging.	01-31-01	01-31-01	
Machine seven K-Q feed cones #18-24.	02-01-01		
Machine three W-band front-end #7-9.	02-13-01		
Machine FE power supply cases.	02-15-01		
Administrative (Scheduling-Safety)			
Design and issue new NRAO-wide Accident Report form.	11-30-00		12-29-00
Conduct Emergency Medical Technicians seminar on the use of Automatic External Defibrillators at AOC.	12-12-00		12-29-00
Arrange removal of used oil and grease by EPA-authorized	12-08-00	01-17-01	
Begin the trial 4/10 work schedule.	01-02-01		
Removal of sludge from used oil tanks.	03-30-01	03-23-01	
Hazardous material inventory (HAZMAT) update.	10-31-01	01-31-01	

Engineering Services

General

The grader failure in February prevented completion of the waveguide lightning protection repairs.

A VLA Site 4/10-hour/day workweek proposal was submitted to upper management. This proposal has been accepted on a trial basis beginning in January of 2001. If the work schedule is successful, it will go into effect permanently in the fall of 2001. A preliminary Work Breakdown Structure for ES Division has been completed.

Computer Division

Hardware

We ordered one DAT DDS-4 drive. Though we have not seen much demand for this format yet, this purchase was prompted by our desire to be able to read tapes visiting scientists may bring.

The planned removal of the old file server 'arana' had to be postponed because of licensing issues involving two minor software packages. These issues are almost resolved now.

Networking and Communications

In our continuing effort to increase security, the majority of the router filter lists which control incoming connections from the Internet to AOC and VLA systems have been added. The router currently blocks all packets not explicitly permitted. We will be fine-tuning the access list from time to time as changes in required services dictate.

The upgrade of the AOC-VLA communications was completed. This project involved replacing various pieces of obsolete equipment with modern terminal servers. An AOC-VLA backup connection was tested successfully, and documentation on how to use this backup connection was written.

The planned purchase and installation of Video Conferencing equipment is pending while we wait for funding.

Systems Support

All AOC and VLA Linux machines which could be upgraded have been upgraded to Redhat 6.2. Due to the release schedule dictated by Redhat we will actually make a start with upgrading these systems to Redhat 7.1 late in the next quarter.

We are currently testing and upgrading our existing Sparcs to Solaris 2.8. In an NRAO-wide effort, we plan to begin upgrading systems early next quarter. A complication is that eight to ten year old machines with the Sun4c chip (IPCs, IPXs, and Sparc 2s.) cannot be upgraded. In anticipation of this (and because of their advanced age), we have made replacement of these systems a priority during the last few years, but because of insufficient funding there still are some of these machines at the AOC and the VLA.

We also are testing our upgrade path to Windows 2000. We already have a few test machines installed and will begin installing production Windows 2000 systems onto the network this quarter.

Testing of the new Unix printing system CUPS is continuing. All AOC printers have been successfully configured; CUPS will be installed at the VLA after we have completed the implementation at the AOC. We are currently fine-tuning the configurations to gain maximum functionality from our current printers. The definite transition to CUPS at the AOC is foreseen for mid to late January.

NRAO-NM computing is working closely with the computer divisions in Tucson, Green Bank, and Charlottesville to begin migrating the various computing branches toward a common design. This three- to four-year cooperative effort addresses all new and existing services such as ftp, mail, etc. as well as operating system upgrades such as Solaris 2.8.

VLBA Support

Obsolete VME hardware has been removed from the critical equipment path and I/O ports reassigned where required. Modifications to the operating system to support this as well as upgrading to the latest revision level also have been completed. The upgraded hardware/software is currently running on the station test fixture at the AOC and will be deployed on the array at a later stage.

VLBA Correlator

Tape statistic SQL transfers now are operational with improved control over maximum file size limits. CALC models now may be switched from internal to external server via operator screen interface. The primary VLBA distribution system has been moved from a Sun IPC to an Ultra 1.

The Operations Management System (OMS) has been tested successfully by Operations in parallel with CJOBS, one of the programs that OMS is targeted to replace. This replacement is due to occur in the first quarter of 2001. A new OMS tool that will allow job script management is currently in the planning phase; a preliminary version will be available early 2001.

VLA Support

VLA observing with the Pie Town antenna was started successfully in October. The involvement of the Computer Division was in two areas: adaptation of the VLA real-time system, and modifications to the VLA scheduling software Jobserve.

Version 1.6.1 of Jobserve was released. This version contains fixes for a number of problems that in-house testing had revealed.

In the correlator controller upgrade project, final correlator hardware configuration bugs have been traced and corrected, resulting in valid self-test results in all modes. A number of timing issues with reading self-test results back from the correlator error memory still remains, but the problem is understood and correctable. Operator interface screens allowing access to the self-test results at the operators station have been implemented. Groundwork has been put in place to allow identification of faulty hardware, and if self healing is possible, the appropriate back up hardware is switched online. The next step in the project is to test and install the array processor.

ELECTRONICS DEVELOPMENT

Major Developments

Milestone	Original Date	Revised Date	Date Completed
Refine 4-12 GHz amplifier.	02-16-01		
Design L-band amp using InP devices.	03-16-01		
Document 3-13 and 8-18 amps for production.	12-15-00		12-15-00
Deliver 30 production amplifiers.	12-29-00	12-22-00	12-22-00
Improve noise test systems.	03-16-01		
Complete 84-116 GHz SIS mixer design.	02-16-01		
Initial tests of 211-275 GHz balanced sideband-separating SIS mixer.	12-27-00	12-01-00	12-01-00
Demonstrate 211-275 GHz single-ended SIS mixer with 4-12 GHz integrated amplifier.	12-27-00	11-15-00	11-15-00
Demonstrate 211-175 GHz balanced sideband-separating mixer with integrate IF preamp.	07-31-01		
Initial tests of 600-720 GHz SIS mixer.	03-16-01	01-31-01	
Design vacuum windows for ALMA Band 3.	12-27-00	12-01-00	12-01-00
Design vacuum windows for ALMA Band 6.	12-27-00		12-27-00
Study use of SS w/g in LO/mixer fabrication for ALMA receivers.	03-16-01		
Measurements of absorbing materials as IR-blocking filters.	03-16-01		
Develop Noise Source for testing/calibrating ALMA Band 3 and Band 6 SIS receivers and materials.	03-16-01	12-01-00	12-01-00
Write revised SIS mixer section of ALMA Project Book.	12-01-00		12-01-00
Complete X-band feed tests.	12-27-00	12-01-00	12-01-00
Complete Ku-band feed tests.	12-27-00	12-01-00	12-01-00
Design quadrature hybrids.	12-27-00	12-01-00	12-01-00
Deliver antenna test correlator.	12-27-00	01-31-01	
ALMA Correlator: 1) Successful preliminary testing of the prototype filter PCB. 2) Receive prototype PCBs for the station card and the filter card test fixture. Initiate parts assembly of the station and filter test fixture cards. 3) Perform final design review of the 4096-lag ALMA correlator chip. 4) Start software simulation of the ALMA correlator chip using commercial simulation package. Write C-language program to do independent verification of the chip test vectors. 5) Write software for the Infineon microprocessor which will be used on the ALMA correlator control cards.	12-31-00		12/31/00

Milestone	Original Date	Revised Date	Date Completed
ALMA Correlator: 1) Construct and test the filter card/station card test fixture. 2) Perform final testing of the filter card using the test fixture. 3) Start testing of the station card (without the test fixture). 4) Start tests on the LTA card. 5) Approve correlator chip for prototype fabrication. 6) Have working software for the correlator system Infineon microprocessor in both the LTA and filter/station card test fixture.	03-31-01		
Initial test of prototype ALMA correlator.	12-21-01		
Write revised correlator section of ALMA Project Book.	12-01-00		12-01-00
Write revised LO sections of ALMA Project Book.	12-1-00		12-01-00
Power amplifier assembly training.	12-07-00		12-07-00
Complete 80/240 GHz tripler design.	12-27-00	01-12-01	
Development of 80-240 GHz tripler mask set.	12-27-00	01-12-01	
Contract for development & fabrication of monolithic frequency multipliers.	01-31-01		

Amplifier Design and Development

New development work was focused on refining the 3-13 GHz design, using both 200-micron TRW and 400 micron NRAO devices. Initial work on an L-band design using Indium Phosphide devices was begun. Production documentation of the 8-18 GHz and 3-13 GHz designs was completed. The 8-18 GHz and 3-13 GHz amplifiers will become standard production models during the first quarter of 2001. Two of the 3-13 GHz amplifiers were delivered to the CDL SIS group for evaluation in a double balanced amplifier configuration.

Amplifier Production

A total of 17 amplifiers was completed during the quarter. Production included: six K-band, two K_a-band, four W-band, and five newly designed 3-13 GHz amplifiers. A total of 30 amplifiers received final test and documentation during the quarter and were delivered to the community.

The CDL amplifier group has continued to support the ALMA project with personnel and construction assistance in the SIS-integrated amplifier development effort. Technicians within the amplifier group have continued with modifications and improvements to the Apple II-based noise measurement systems. The NRAO-manufactured YIG oscillator frequency sources have been packaged in a near commercial configuration with proper thermal management for improved reliability and longevity.

Superconducting (SIS) Millimeter-Wave Mixer Development

SIS Mixer Development

84-116 GHz SIS mixer: The choice between SIS and HFET receivers for ALMA Band 3 is still open. To obtain a comparison between the two types of receiver, we are developing a tunerless SIS mixer capable of operation with a 4-12 GHz IF for this band. A fixed-tuned waveguide probe with return loss better than 25 dB has been designed using

QuickWave. Other parts of the mixer circuit are currently being designed and optimized using Sonnet and MMICAD. Mixer design and mask layout should be completed by the end of January.

211-275 GHz balanced sideband-separating mixer: Initial tests using an L-band IF are imminent. A new mixer block is being designed to allow these mixers to operate with the 4-12 GHz IF amplifiers now under development.

600-720 GHz SIS mixer: SUNY/Stony Brook delivered a new batch of the 600-720 GHz mixer chips with improved I-V characteristics in late December 2000. We are now assembling the first mixer and will start the RF evaluation of the mixer when it is ready.

Vacuum Windows

Vacuum windows are required for the ALMA SIS mixer production test receivers and also for the receivers on the ALMA Test Interferometer. We have finalized the window designs for Bands 3 and 6 on the Test Interferometer. The first window for Band 3 is complete and ready for delivery. During this development, QMC Instruments (UK) offered to produce low-loss vacuum windows for Bands 3 and 6, similar in design to those we had developed (crystal quartz with anti-reflection layers on both sides), thus providing a commercial source of vacuum windows for ALMA. We have tested these prototypes and they perform well—see ALMA Memo #340.

Overmoded Waveguide

Overmoded stainless steel waveguide is being considered for connecting the LO to the mixer in ALMA receivers. The characteristics of E- and H-plane bends in overmoded waveguide circuits are being studied using a FDTD simulator (QuickWave) to determine whether there are any undesirable resonances and, if so, how to eliminate them.

Absorbing Materials

For the ALMA SIS mixer production test receivers, and also for the receivers on the Test Interferometer, infrared filters are needed with low RF loss and high IR attenuation. Measurements are under way to determine the effectiveness of various materials as IR-blocking filters. Preliminary data agree with earlier results from D'Addario (ALMA Memo #269), and new materials are being tested.

Ten commercial microwave and millimeter-wave absorbing materials were measured at W-band (75-110 GHz) using a VNA to determine their transmission and reflection characteristics—see ALMA Memo #328.

Millimeter-Wave Noise Source

We have developed a high-level broadband millimeter-wave noise source for testing and calibrating ALMA Band 3 (84-116 GHz) and Band 6 (211-270 GHz) SIS receivers and materials. The noise source consists of a microwave solid-state noise source, followed by microwave amplifiers, a frequency multiplier and a feed horn. It is reasonably compact and inexpensive, and can be used in many millimeter-wave applications. Feasibility of using this technique to generate high-level noise into the Terahertz range will be explored when resources are available.

SIS Mixer Testing

For automatic mixer and receiver testing, it is necessary to switch rapidly between hot and cold loads. At millimeter wavelengths, room temperature and liquid nitrogen provide convenient reference temperatures. To switch the receiver input between the two reference temperatures, a chopper wheel is used, but calibration errors are easily introduced by beam spillover which misses the cold load, loss in the reflectors used to steer the beam to the loads, condensation or fog on or above the cold load, and reflections or scattering at the surface of the liquid nitrogen bath containing the cold

load. We have completed calibration and alignment of the chopper wheel noise temperature measurement system. The chopper wheel is now routinely used in lieu of manual loads to measure receiver noise temperatures.

We have begun testing a solid-state noise source that may eventually replace the liquid nitrogen-based cold load for receiver noise temperature measurements.

We continued the design and coding of the new measurement software by creating and updating activity diagrams and sequence diagrams to allow stepping of any desired receiver parameter during data collection and display.

For the test receivers to be used for ALMA mixer production, we are evaluating a modification of the present CDL mixer bias supply to use a balanced current source. This will be less subject than the present single-ended current source to the ground-loop problems often encountered in receiver bias circuits.

Reed relays have been tested for voltage transients (often found in microwave switches at a level dangerous to SIS mixers). It appears that reed relays can safely be operated while connected to an SIS mixer.

Broadband IF Development

We have measured the performance of the prototype 4-12 GHz IF amplifier with three different Band 6 single-ended mixers. All three showed similar noise performance—the best had a measured noise temperature of 60 ± 10 K DSB across the whole 4-12 GHz IF band.

Development of a preamp for use with balanced mixers (and balanced sideband separating mixers) has begun. This preamp contains two bias-T's to provide the mixer bias through the IF connections to the two outputs of the balanced mixer.

To operate a balanced mixer without a 180-degree IF hybrid, a 2:1 impedance transformer is required between the mixer and preamp in each IF line. We have designed such a transformer, whose electrical length is small enough not to degrade substantially the noise matching between mixer and preamp.

A prototype preamp has been built using the latest batch of InP devices. This amplifier has a noise temperature of 3-6 K over 4-12 GHz, approximately half that of the present design.

Publications

G. A. Ediss, S.-K. Pan, J. Effland and T. Globus, "Measurements of Commercial Vacuum Windows for ALMA Bands 3 and 6," ALMA Memo #340, December 2000.

G. A. Ediss, "Room Temperature Measurements of Various Absorbers With the HP8510 at 75-110 GHz," ALMA Memo #328, October 2000.

A. R. Kerr and N. Horner, "A Broadband In-Phase Waveguide Power Divider/Combiner," ALMA Memo #325, October 2000.

Electromagnetic Support

GBT

Far-field pattern measurements were completed on the X-band (8-10 GHz) and the K_u-band (12-15.4 GHz) feeds.

For the X-band feed, the pattern level at the edge of the subreflector varies between -12.5 dB and -13.5 dB in the 8.0 to 10.0 GHz range. The worst-case cross-polarization level is 31.0 dB below the peak of the copolar beam. At 9 GHz, the phase center location is 16.24" behind the aperture of the feed and varies by ± 0.100" at the high and low ends of the band.

The K_u-band feed yielded pattern levels at the edge of the subreflector varying between -12.8 and -13.5 dB with good match between the patterns in the two principal planes. Cross-polarization level is lower than -28 dB in the frequency band. Phase center locations are 9.50" at 12 GHz, 9.75" at 14 GHz, and 9.91" at 15.4 GHz behind the aperture plane.

General

A set of waveguide branch line quadrature hybrids for the 75-110 GHz band was designed. The hybrids are used in balanced mixers and amplifiers, sideband-separating mixers and power dividers. The hybrids are suitable for fabrication on a CNC machine and can be scaled to any waveguide band up to 700 GHz. The amplitude imbalance is $\leq$ 0.5 dB and phase imbalance is $\leq$ 1.0 degree. Three hybrids have been designed in the following frequency ranges: 73.8-95.0 GHz, 82.6-106.5 GHz and 83.9-110 GHz. A space mapping technique, where the advantages of an approximate circuit simulator (MMICAD) were combined with that of an accurate EM simulator (QuickWave), was used in the design.

Spectrometers/Correlators

Testing of the first hardware for the ALMA correlator was started during the last quarter when the prototype of the ALMA correlator filter card was assembled and extensively exercised in a stand-alone mode.

Testing of the filter card as an actual digital filter was not possible due to the unavailability of the card test fixture. However, all of the card chip-to-chip interfaces were tested, as well as internal functions of the field programmable gate array chips. All tests performed were successful and indicated a reasonable operating margin. A test report was written and published on the web.

Several other multi-layer printed circuit cards, including the station card, the filter card/station card test fixture logic card and backplane, were received and sent out for parts assembly. The printed circuit board for the prototype LTA was expected during December, but fabrication difficulty has delayed it into early January 2001.

The ALMA correlator chip design project is nearing completion. Earlier this year, the chip design and layout were completed and an extensive design rules check started. A final design review of the chip was held in October.

The ALMA correlator group purchased software to perform computer simulations of the correlator chip design after the October design review and has spent several weeks doing simulations. As much as 1/4 of the chip has been simulated at once here in Charlottesville. Simulation of the entire chip will be done with a faster computer with more memory that will become available in January.

During this quarter, a small amount of assistance was provided to Green Bank in support of the GBT spectrometer. Some assistance was also provided to Five College Radio Astronomy Observatory (FCRAO). Some years ago FCRAO purchased some GBT spectrometer logic cards which are now being used in the process of testing their spectrometer.

A small amount of work on the ALMA test correlator was also required.

A test layout of the ALMA correlator card was performed after approximate pinouts of the correlator chip become known. This card is expected to present a very difficult layout task which cannot be started until completion of the chip design.

A considerable amount of work was expended during the quarter to define the software environment required for microprocessors to be used in the ALMA correlator.

ALMA LO Source

The purpose of this project is to develop a series of electronically-tunable, phase-locked sources operating near 100 GHz. These sources will be used to drive millimeter- and submillimeter-wave frequency multipliers that produce the first-LO signal for the ALMA receivers.

Much of the work this quarter centered on writing the LO sections of the ALMA Project Book and related memoranda. A contract with JPL for MMIC power amplifiers was finalized and delivery of the first set of amplifiers occurred in early December. Two members of the LO Group spent a week at JPL learning to work with the MMIC chip components in preparation for future power amplifier assembly work at NRAO.

ALMA Frequency Multipliers

The purpose of this project is to develop millimeter- and submillimeter-wave frequency multipliers for use in laboratory experiments and receiver systems associated with ALMA. A series of multipliers using varactor and varistor circuits operating in the 50 to 950 GHz range is being developed. We have an ongoing contract with the Semiconductor Device Laboratory at the University of Virginia (UVA) to support semiconductor device research.

The design of the 80/240 GHz tripler was finalized this quarter with completion of the integrated capacitors. Work is currently focused on the mask set needed for the semiconductor fabrication process. The semiconductor wafers have been ordered. The first batch of triplers is expected next quarter.

A collaboration with JPL and the University of Michigan for the development and fabrication of monolithic frequency multipliers, primarily for the submillimeter ALMA bands, has been finalized. A contract with the University of Michigan was successfully negotiated and is in place. The contract centers around the development of (1) diode arrays for 110/220 GHz frequency doublers, (2) MMIC doubler chips for ALMA Band 7, and (3) MMIC tripler chips for ALMA Band 9. Fabrication of the diode array is currently under way and delivery is expected early next quarter.

Also in collaboration with the UVA group, we have successfully molded a polyurethane (PUR) replica of the 55/110 GHz doubler. We have had success in obtaining reasonably good metal deposition on the PUR block using a modified sputtering process, and fabrication of a complete 55/110 GHz doubler is currently under way. RF tests are expected early next quarter.

Fully-Sampled, Focal Plane Array Feed

The purpose of this long-term development project is to explore the technical challenges associated with the development of a "radio camera" for imaging applications on single-dish telescopes. The camera consists of a two-dimensional array of receiving elements located on the telescope's focal plane. These elements sample the focal plane electromagnetic field distribution, yielding complex signals that are processed using both analog and digital techniques to synthesize the desired number of telescope beams. We are currently working on the third generation of the 19 element proof-of-concept system.

During this quarter, we have concentrated our efforts on improving the calibration procedure for the antenna impedance measurements. A set of measurement standards was designed and is currently being fabricated. Measurements of the sinuous antenna feed-point impedance should resume early next quarter.

Advanced Radio Frequency Interference Canceling System

The purpose of this long-term development project is to apply modern digital signal processing technology to the ever-growing problem of radio interference. Modern adaptive signal canceling methods are currently being analyzed and applied to system-noise-limited measurements of very weak cosmic signals. Our long-term goal is to develop a RFI excision system that is integrated with the GBT back-end electronics and is capable of canceling interference from both terrestrial and satellite sources, thus opening new spectral windows for astrochemistry and highly red-shifted HI measurements. We are currently in the first phase of our proof-of-concept system.

During this quarter, we continued to make improvements to the current hardware-based, proof-of-concept system. The various component modifications were completed and the system was evaluated in December using the spectral processor in Green Bank. Results of the measurements will be presented at the URSI meeting in January.

Meetings

Members of the CDL attended the following meetings this quarter:

European Microwave Conference, Paris, France, Sept. 29-Oct.7, 2000 (Pospieszalski)

ALMA Meeting (Antenna CDR), Garching, Germany, Nov. 28-Dec. 3, 2000 (Webber).

DATA MANAGEMENT

Data Management is organized as follows:

- Data Management Initiative: has the goal of improving end-to-end data handling for all NRAO telescopes,
- Technology Infrastructure: provides technology infrastructure for DM activities
- Telescope Computing: oversees telescope-related computing issues,
- Central Computing Services: provides observatory-wide computing services, and support for computing at the NRAO headquarters.

Data Management Initiative

Milestones	Original Date	Revised Date	Date Completed
Setup Scientific Working Group	10-01-00	11-06-00	11-06-00
COBRA pre-proposal submitted	10-14-00	10-29-00	10-29-00
NVO pre-proposal submitted	11-04-00		11-04-00
DM 2001 budget submitted	09-01-00	09-25-00	09-25-00
Definition of DM processes	11-01-00	02-01-01	
ALMA software task division	08-01-00	02-01-01	
DM-wide WBS established	12-15-00	01-15-01	01-22-01
GBT proposal prototype deployed	10-02-00		10-02-00
DM WBS out to 2006	02-01-01		

Work on the Data Management Initiative continued to focus on planning and on acquiring resources. A Scientific Working Group to advise and work on the DMI has been established. The DMI Project Scientist, Frazer Owen, heads this group of NRAO scientists. Definition of DM processes has continued in collaboration with the Data Management Executive Committee. Planning has proceeded via the construction of a WBS for all DM activities.

Work has continued on aligning the proposed division of ALMA software tasks with the overall imperatives of the DMI. This is in collaboration with the ALMA Project Management. A proposal is currently in draft form.

The NRAO has collaborated with NCSA and NAIC in a pre-proposal to the NSF Information Technology Research program. The goal is to establish a Common grid-Based Radio Archive (COBRA) to develop and use pipelined processing techniques and archives for radio astronomy data. NRAO also collaborated with a large range of different organizations, principally JHU and Caltech, in the submission of a pre-proposal to establish a National Virtual Observatory. Full proposals are due in April 2001, provided the pre-proposals pass the first cut.

Finally, although the resources for the DMI are currently very limited, we have been able to start an initiative to restructure NRAO proposal handling procedures. The goal is to move to an observatory-wide approach to submitting and handling proposals. For the GBT, a prototype based on the Gemini Proposal Submission Tool has been issued and is now in use (and evaluation). The same tool and a web-based alternative are being adapted for the VLA.

Further planning in DM is on hold pending determination of the NRAO budget.

Technology Development

Milestones	Original Date	Revised Date	Date Completed
VLA end-to-end in AIPS++	10-01-00	10-13-00	10-13-00
AIPS++ Release 1.4	10-20-00	11-13-00	11-13-00
WBS for AIPS++ Release 1.5	10-20-00	12-04-00	12-04-00
AIPS++ demo at ADASS	11-13-00		11-13-00

Milestones	Original Date	Revised Date	Date Completed
Start of GBT commissioning	11-29-00	01-19-01	
AIPS++ tutorial at CV	12-17-00		12-17-00
AIPS 31DEC00 freeze	12-31-00	01-31-01	
AIPS++ Developer's Pre-release	09-24-00	04-01-01	
AIPS++ booth at AAS	01-07-01		
AIPS++ User Group meeting	01-29-01		
Parallel wide-field imaging	03-01-01		

Technology development for the DM is based mainly around the AIPS++ package. A very significant milestone was the completion of end-to-end processing for the VLA within AIPS++. This was demonstrated by the processing of a ten-pointing mosaic observation of Orion entirely within AIPS++, from filling, through editing, calibration, and imaging. This capability is present in the recent (Nov 2000) release, version 1.4, of the package, though we expect the documentation and ease of use to be considerably improved in version 1.5 due to be released in April 2001. The NRAO AIPS++ User Group has participated extensively in testing and providing feedback on the package.

The third public release of AIPS++, version 1.4, was released as planned at the Astronomical Data Analysis Software and Systems meeting in Boston mid November. This release brings significant improvements in most aspects, ranging from the user interface, to the applications such as single dish analysis, synthesis data reduction, and image display and analysis. In addition to distributing a total of about 400 CDROMs at ADASS and at the AAS, we mailed approximately 250 CDROMs in response to requests.

A pre-release for AIPS++ developers has been deferred until the second quarter 2001. Instead we have worked directly with a number of non-consortium developers to establish regular downloads and local builds of the development system. This level of support is sufficient to allow various key external groups to work within the package. The groups being supported in this way include the Navy Prototype Optical Interferometer at NRL and USNO, the Sub-Millimeter Array at the Center for Astrophysics, the Dominion Radio Astrophysical Observatory, the Royal Observatory, Edinburgh, and ALMA development groups at l'Observatoire de Paris and at IRAM, Grenoble.

In keeping with the NRAO-wide adoption of WBS for planning, the development plan for Version 1.5 of AIPS++ was cast in WBS format.

AIPS continues to be supported by a three-person group. Yearly releases are planned for a few years yet to come. Some moderate development continues as required to support new capabilities on the VLA and VLBA, but the bulk of the effort is in maintenance and support. The next release will be December 15, 2001.

Telescope Computing

Milestones	Original Date	Revised Date	Date Completed
Deploy CJOBS in VLBA correlator	02-15-01		
Automate VLA pointing processing	03-01-01		
Long-term VLA pointing analysis	03-01-01		
Preliminary test of new VLA correlator controller	03-15-01		
Test SLC/DCS on VLA	03-01-01		

The New Mexico Array Support Group (ASG) regrettably lost its manager at the beginning of the quarter; there are now two open positions in the group. Although a candidate was found to fill the other open position, regrettably she declined the offer. This has meant that progress has been slower than planned. The replacement of the VLBA correlator

control system (OBS) with a more modern GUI-based version (CJOBS) is proceeding well. We hope to have this deployed in the first quarter of 2001.

We plan to automate some of the features of the present VLA on-line system to free programming time for work on the EVLA design. Towards this end, the VLA pointing data processing will be more automatic by next quarter. In addition, the analysis of the long-term trends in pointing solutions should also be completed. Work is progressing on the interfacing of the Serial Line Controller to a newer computer system. Development of the replacement of the present VLA correlator controller and array processor has also progressed to a point where we expect to be able to make preliminary tests in the next quarter.

Central Computing Services

Milestones	Original Date	Revised Date	Date Completed
AOC compliant with security	12-31-00	11-09-00	11-09-00
Tucson compliant with security	12-31-00	01-31-01	
Replace VLBA routers	12-01-00	12-31-00	12-01-00
Improved filtering at AOC	12-31-00		12-31-00
AMTF phase 1 rollout	10-07-00	10-17-00	10-17-00
AOC high-speed link	10-01-00	01-31-01	
Windows 2000 allowed	01-01-01	01-31-01	
800 service switched to FTS2001	02-01-01		
Satellite ISDN link to Chajnantor	02-01-01		
New Intranet contract	02-15-01		
Revise security policy	02-15-01		
Upgrade SSH	03-01-01		
Web-server design	11-16-00	02-01-01	
Web-server deployment	03-01-01		
CCE design	03-31-01		

One of the provisions of the NRAO Computing Security Policy is to minimize potential intrusion paths by blocking all services except those that are required from outside of the NRAO. The primary goal in this area for the last quarter of 2000 was to bring the remaining sites, New Mexico and Tucson, into compliance with this requirement. This goal has been largely met: at all sites except Tucson, our Internet gateway routers are now fully compliant. In Tucson, the service specifications have been completed and will be implemented shortly.

Other security tasks currently underway are:

- Upgrading to a superior version of the SSH package under UNIX at all NRAO sites, including maintaining a central database of NRAO host keys;
- Investigating Virtual Private Networking (VPN) solutions to address the needs of employees who are required to work frequently or for extended periods of time at non-NRAO locations (this is particularly important for ALMA staff) and in support of telecommuting during construction at Edgemont Road in Charlottesville; and
- Revising the Policy to accommodate special-purpose Web servers and VPN issues.

In addition, this next quarter we plan to begin examination of techniques to make status monitoring and intrusion detection manageable with the staff available.

Due to delays in the installation of a T3 (45Mbps) circuit between Socorro and Albuquerque, the connection of the AOC to the high-speed Abilene and vBNS+ networks has not yet been completed. We therefore postponed purchase of the equipment necessary to meet our goal of upgrading the Ethernet link between the AOC and the New Mexico

Institute of Mining and Technology in preparation for this connection, until late 2000; the equipment has been received and will be installed in mid-January 2001.

Because the new Government Service Administration (GSA) Federal Telecommunications Service (FTS2001) contract was awarded to different contractors than the old GSA FTS2000, the NRAO has had to plan the transition of many of its phone and network services. We have begun the process of changing the calling card services to the new contract. First we will convert all of the cards used in Charlottesville. When this service is stable, we will consider changing the cards used at the other sites. We have also begun the process of changing our internal 800 numbers to the FTS2001 service. Both of these changes should be complete in the first quarter of 2001. The transition of our internal network (intranet) between the sites is more problematical—we cannot afford any significant outage in this service and the cost of continuing with the old FTS2000 would increase significantly. We are investigating other government contracts that will allow us to continue to provide the service without major interruption. We are also developing an ISDN link via satellite to the ALMA site in Chajnantor, Chile.

During the last quarter of 2000, significant progress was made on several major projects involving NRAO computer systems support staff. These projects include planning for Windows 2000 deployment; improving web services by "mirroring" the NRAO Web pages across multiple sites; and reducing differences in the configuration of UNIX environments across the NRAO from both user and system perspectives, which in turn will improve system dependability. Working groups have been established in all of these areas, and roadmaps have been created to define directions and basic timelines.

A plan for revising and improving NRAO's Web Presence was drafted, and a group of Web Administrators assembled for plan finalization and implementation. Computer Documentation continues to be consolidated in the "Gold" book, CV Computing Web Pages, and more.

The Archive Media Transfer Facility (AMTF) infrastructure was created and Phase one (9-track transfer) put into operation.

TELESCOPE USAGE

The following telescopes have been scheduled for research and maintenance in the following manner during the fourth quarter of 2000.

	VLA	VLBA
Scheduled Observing (hrs)	1625.80	1263.50
Scheduled Maintenance and Equipment Changes	227.80	264.00
Scheduled Tests and Calibration	299.40	202.00
Time Lost	75.30	60.90
Actual Observing	1550.50	1202.60

VERY LARGE ARRAY OBSERVING PROGRAMS

The following research programs were conducted with the VLA during this quarter:

No.	Observer(s)	Programs
AA252	Alexander, P. (Cambridge) Clemens, M. (Cambridge)	The ISM in interacting/merging galaxies. 20 cm
AA254	Anglada, G. (IAA, Andalucia) Rodriguez, L. (Mexico/UNAM) Torrelles, J. (IAA, Andalucia)	The L723 quadrupolar molecular outflow. 3.6 cm
AB901	Blomme, R. (Royal Observatory) Prinja, R. (U. College London) Runacres, M. (Royal Observatory)	Radio monitoring of hot-star winds. 3.6, 6 cm
AB923	Bicknell, G. (Mt. Stromlo) Allen, M. (Toronto) Morganti, R. (NFRA)	Origin of radio emission in Seyfert galaxy NGC 2992. 20 cm
AB972	Beasley, A. (OVRO) Claussen, M. Palma, C. (Virginia) Majewski, S. (Virginia)	Search for SiO masers in globular clusters. 0.7 cm
AB973	Benson, J. Ulvestad, J.	Radio variability in compact Seyfert galaxies. 3.6 cm
AB974	Black, G. Campbell, D. (Cornell) Nicolson, P. (Cornell)	Saturn occultation candidate sources. 3.6, 20 cm

No.	Observer(s)	Programs
AB976	van Breugel, W. (LLNL) Lacy, M. (UC, Davis) de Vries, W. (LLNL) Stanford, A. (LLNL) Becker, B. (UC, Davis) Moran, E. (UC, Berkeley) Dawson, S. (UC, Berkeley) Golap, K. Dey, A. (KPNO-NOAO) Januzzi, B. (KPNO-NOAO) Eisenhardt, P. (JPL) Stern, D. (JPL) Rottgering, H. (Leiden) Morganti, R. (NFRA) Spinrad, H. (UC, Berkeley)	Deep P-band observations of the NOAO deep wide field survey. 90 cm
AB977	Braatz, J. Greenhill, L. (CfA) Sand, D. (Caltech)	Maser disk in IC 1481. 1.3 cm
AB978	Best, P. (Royal Obs) Cimatti, A. (Arcetri) Rottgering, H. (Leiden)	Radio source size and polarization evolution. 3.6, 6 cm
AB979	Blundell, K. (Oxford) Cruz, M. (Oxford) Rawlings, S. (Oxford)	First z > 4 radio quasars from a VLA 74 MHz survey. 3.6 cm
AB981	Blundell, K. (Oxford) Close, L. (Oxford)	Multi-frequency high resolution study of hotspots. 0.7, 1.3 cm
AC467	Colina, L. (Cantabria) Alberdi, A. (IAA, Andalucia) Torrelles, J. (IAA, Andalucia) Panagia, N. (STScI) Wilson, A. (Maryland)	Search for radio supernovae in luminous Seyfert galaxies. 2, 3.6 cm
AC524	Cartwright, J. (Caltech) Taylor, G. Readhead, A. (Caltech) Pearson, T. (Caltech)	Polarization monitoring observations of 3C273. 0.7, 1.3 cm
AC557	Clarke, T.	Search for polarized sources behind galaxy clusters. 6 cm
AC558	Condon, J.	Radio jet from an Scd galaxy? 20 cm

No.	Observer(s)	Programs
AC559	Charmandaris, V. (Cornell) Combes, F. (Paris Obs) Liszt, H.	OH and HI absorption from the HVC toward B1923+210. 20 cm
AC560	Claussen, M. Goss, W. M. Brogan, C. Desai, K. (Renaissance Tech)	Scattering in the direction of 1720 MHz OH masers in W28. 6, 20 cm
AC561	Cesaroni, R. (Arcetri) Hofner, P. (NAIC) Walmsley, C. M. (Arcetri) Kurtz, S. (Mexico/UNAM) Churchwell, E. (Wisconsin)	Structure of hot cores: ammonia (4,4) observations. 1.3 cm
AC562	Curiel, S. (Mexico/UNAM) Trinidad, M. (Mexico/UNAM) Torrelles, J. (IAA, Andalucia) Canto, J. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Gomez, J-L. (IAA, Andalucia) Ho, P. (CfA)	Radio jet/water maser systems around YSOs. 1.3 cm
AC563	Curiel, S. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Moran, J. (CfA) Canto, J. (Mexico/UNAM) Raga, A. (Mexico/UNAM)	Monitoring of the Serpens Radio jet. 2, 3.6, 6 cm
AC564	Cotton, W. Spencer, R. (Manchester) Saikia, D. (TIFR) Garrington, S. (Manchester)	Faraday rotation and jet deflection in 3C43 and 3C454. 2 cm
AC565	Cotton, W. D. Perrin, G. (Paris Obs) Woillez, J. (Paris Obs) Sol, H. (Paris Obs) Jaffe, W. (Leiden) Mennesson, B. (Leiden)	Search for thermal emission near the nucleus of NGC 1068. 0.7 cm

No.	Observer(s)	Programs
AC566	Crocker, M. (Manchester) Eyres, S. (Liverpool) Davis, R. (Manchester) O'Brien, T. (Manchester) Bode, M. (Liverpool JMU) Skopal, A. (Liverpool) Taylor, A. (Calgary)	Jet dynamics in the symbiotic star CH Cygni. 2, 3.6, 6, 20 cm
AC569	Capak, P. (Hawaii) Tonry, J. (Hawaii) Gregory, P. (British Columbia)	Identification of variable radio sources. 3.6, 20 cm
AC570	Conway, J. (Chalmers, Onsala) Pihlstrom, Y. (Chalmers, Onsala)	Search for H I absorption in $z < 0.2$ narrow line radio galaxies. 20 cm
AC571	Carilli, C. Bertoldi, F. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Omant, A. (IAP, Paris) Cox, P. (Marseille Obs) McMahon, R. (Cambridge) Isaac, K. (Cambridge)	High redshift QSOs from the Palomar Digital Sky Survey. 20 cm
AC572	Clarke, T.	High resolution faraday study of compact cluster core sources. 20 cm
AC573	Curiel, S. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Girart, J. (Illinois) Trinidad, M. (Mexico/UNAM)	The YLW 15 binary system. 0.7 cm
AD439	De Pree, C. (Agnes Scott College) Wilner, D. (CfA) Goss, W. M. Kurtz, S. (Mexico/UNAM)	Ionized gas velocities in hyper-compact HII regions in W49A. 0.7 cm
AD440	Van Dyk, S. (IPAC)	Searching for radio supernovae in Wolf-Rayet galaxies. 6, 20 cm
AD442	Dufton, Q. (Toronto) Kronberg, P. (Toronto) Allen, M. (Toronto)	Second epoch observation of starburst galaxy NGC 3448. 6 cm
AD443	Doeleman, S. (Haystack) Lonsdale, C. (Haystack)	The extended SiO maser emission in Orion KL. 0.7 cm

No.	Observer(s)	Programs
AE138	Eales, S. (Wales) Carilli, C. Dunne, L. (Wales) Yun, M. (UMASS) Lilly, S. (Toronto) Gear, W. (Wales)	Star formation in two CFRS survey fields. 20 cm
AF370	Falcke, H. (MPIR, Bonn) Brunthaler, A. (MPIR, Bonn) Bower, G. (UC, Berkeley) Aller, M. (Michigan) Aller, H. (Michigan) Terasranta, H. (Helsinki)	III Zw 2, a superluminal jet in a spiral galaxy. 0.7, 1.3, 2, 3.6, 20, 90 cm
AF374	Felli, M. (Arcetri) Cesaroni, R. (Arcetri) Testi, L. (Arcetri) Chini, R. (Bochum) Nielbock, M. (Bochum)	Measuring the expansion of the UC HII region M17-UC1. 1.3, 3.6 cm
AF376	Fey, A. (USNO) Boboltz, D. (USNO) Gaume, R. (USNO) Johnston, K. (USNO) Claussen, M.	Radio star observations for a FAME/ICRF frame tie. 3.6 cm
AF377	Fassnacht, C. (STScI) Rusin, D. (Pennsylvania) Xanthopoulos, E. (Manchester) Koopmans, L. (Manchester)	Monitoring of JVAS and CLASS gravitational lenses. 2, 3.6, 6 cm
AG589	Gudel, M. (SFIT, ETH) Beasley, A. (OVRO) Audard, M. (SFIT, ETH) Benz, A. (SFIT, ETH) Mewe, R. (Utrecht) Brinkman, A. (Utrecht) Savin, D. (Columbia)	Bright stellar coronae observed with XMM. 3.6, 6 cm
AG600	Girart, J. (Illinois) Rodriguez, L. (Mexico/UNAM) Curiel, S. (Mexico/UNAM)	Class 1 protostars with associated X-ray emission. 3.6 cm

No.	Observer(s)	Programs
AG601	Gregg, M. (UC, Davis) Becker, R. (UC, Davis) Laurent-Muehleisen, S. (UC, Davis) White, R. (STScI)	Bright quasar lensing search. 3.6 cm
AG602	Gaensler, B. (MIT) Backer, D. (UC, Berkeley) Stappers, B. (Amsterdam) Strom, R. (Amsterdam) van der Swaluw, E. (Utrecht)	Proper motion of PSR B1951+32 in the supernova remnant CTB 80. 20 cm
AH669	Rupen, M. Mioduszewski, A. (Sydney)	Galactic black hole X-ray transients. 1.3, 2, 3.6, 6, 20 cm
AH685	Haarsma, D. (Calvin College) Hewitt, J. (MIT) Langston, G. Moore, C. (Groningen/Kapteyn)	Time delay monitoring of gravitational lens 2016+112. 3.6, 6 cm
AH707	Helfand, D. (Columbia) Becker, R. (UC, Davis) White, R. (STScI) Warwick, R. (Leicester)	A new X-ray/radio image of the milky way. 20 cm
AH718	Ho, L. (DTM/Carnegie) Ulvestad, J.	AGN Content in late-type galaxies. 6 cm
AH719	Hoare, M. (Leeds) Gibb, A. (Leeds)	High frequency continuum from the ionized winds of luminous YSOs. 0.7, 1.3, 3.6 cm
AH721	Hong, X. (Shanghai Obs) Jiang, D. (Shanghai Obs) Wang, W. (Shanghai Obs) An, T. (Shanghai Obs)	Eight gamma-ray AGNs. 1.3, 3.6 cm
AH723	Hyman, S. (Sweet Briar) Kassim, N. (NRL) Lazio, T. J. W. (NRL)	New galactic center radio transient? 6, 20 cm
AH724	Holzapfel, W. (Chicago) Carlstrom, J. (Chicago) Dawson, K. (AAO)	Point source contamination of BIMA anisotropy fields. 3 .6, 6 cm

No.	Observer(s)	Programs
AI086	Ivison, R. (U. College London) Smail, I. (Durham) Blain, A. (Cambridge) Kneib, J. (Toulouse Obs)	Lyman break galaxy SMM J14011+0252: is it a SCUBA source? 20 cm
AJ276	Jackson, N. (Manchester) McKean, J. (Manchester) Browne, I. (Manchester) Wilkinson, P. (Manchester) Marlow, D. (Pennsylvania) Rusin, D. (Pennsylvania) Helbig, P. (Groningen/Kapteyn)	Parent population of faint flat spectrum radio samples. 20 cm
AK509	Kulkarni, S. (Caltech) Frail, D. Galama, T. (Caltech) Bloom, J. (Caltech) Berger, E. (Caltech) Harrison, F. (Caltech)	Radio afterglows from gamma-ray bursts. 3.6, 6, 20 cm
AK511	Krishnamurthi, A. (Colorado/JILA) Linsky, J. (Colorado/JILA) Osten, R. (Colorado/JILA) Brown, A. (Colorado/JILA) Gagne, M. (West Chester) Ayres, T. (Colorado/JILA)	Observations of AU mic and TZ CrB with Chandra. 2, 3.6, 6 cm
AK518	Koopmans, L. (Manchester) de Bruyn, A. G. (NFRA) Fassnacht, C. (STScI) Wambsganss, J. (API, Potsdam) Blandford, R. (Caltech)	Radio microlensing in B 1600+434. 2, 3.6, 6, 20 cm
AK520	Kurtz, S. (Mexico/UNAM) Hofner, P. (NAIC) Franco, J. (Mexico/UNAM)	Density structure in extremely compact H II regions. 0.7, 2, 6 cm
AK523	Kurtz, S. (Mexico/UNAM) Shepherd, D. Claussen, M.	The massive molecular outflow G192.16-3.82. 0.7, 1.3, 3.6, 6 cm

No.	Observer(s)	Programs
AK525	Keohane, J. (North Carolina) Williams, N. (North Carolina) Clearfield, C. (North Carolina) Olbert, C. (North Carolina) Frail, D.	X-ray point source in IC 443. 20 cm
AL523	Lovell, J. (CSIRO) Winn, J. (MIT) Jauncey, D. (CSIRO) Edwards, P. (ISAS, Japan) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO)	GLASS: the gravitational lens and astrometric southern survey. 2, 3.6 cm
AL525	Lim, J. (SA/IAA, Taiwan) Carilli, C. White, S. (Maryland)	Red supergiant stars. 0.7 cm
AL528	Lazio, T. J. W. (NRL) Lacey, C. (NRL) Cordes, J. (Cornell) McLaughlin, M. (Cornell) Kassim, N. (NRL)	Census of steep spectrum sources in the Andromeda galaxy. 90 cm
AL529	Lacey, C. (NRL) Kassim, N. (NRL) Dyer, K. (North Carolina) Brogan, C. Dwarakanath, K. (Raman Institute) Anantharamaiah, K. (Raman Institute) Bhatnagar, S. (NCRA, India)	Low frequency observations of galactic SNRs. 90 cm
AL531	Lehar, J. (CfA) Buchalter, A. (Caltech) McMahon, R. (Cambridge) Kochanek, C. (CfA)	Gravitationally lensed radio lobes. 6, 20 cm
AM628	Mirabel, I. F. (Saclay) Dhawan, V Rodriguez, L. (UNAM)	Coordinated VLA and XMM observations of the microquasar GRS 1915+105. 2, 3.5, 6 cm

No.	Observer(s)	Programs
AM645	Menten, K. (MPIR, Bonn) Wagner, S. (Heidelberg Obs) Appenzeller, I. (Heidelberg Obs) Carilli, C. Bertoldi, F. (MPIR, Bonn) Fricke, K. (Gottingen)	Survey of the FORS VLT deep field. 20 cm
AM661	Monnier, J. (CfA) Greenhill, L. (CfA) Tuthill, P. (Sydney) Danchi, W. (NASA/GSFC)	Spectral variability of the WR 112 binary system. 0.7, 1.3, 2, 3.6, 6, 20 cm
AM665	McHardy, I. (Southampton) Uttley, P. (Southampton)	Radio variability of the Seyfert galaxy NGC 4051. 3.6, 6 cm
AM668	Menten, K. (MPIR, Bonn) Reid, M. (CfA)	Compact radio sources in Orion KL. 0.7, 3.6 cm
AM669	Marti, J. (Jaen) Paredes, J. (Barcelona) Peracaula, M. (Barcelona)	TOO observations of Cygnus X-3 arcsecond radio jets. 3.5, 6 cm
AM670	Morganti, R. (NFRA) Oosterloo, T. (NFRA) Capetti, A. (Torino) Parma, P. (Bologna) Wills, K. (Sheffield) deRuiter, H. (Bologna) Fanti, R. (Bologna)	HI absorption lines in FRI radio galaxies. 20 cm line
AM671	Muxlow, T. (Manchester) Pedlar, A. (Manchester) Wills, K. (Sheffield) McDonald, A. (Manchester)	Starburst galaxy M82. 2 cm
AM672	Murphy, D. (JPL) Marshall, H. (MIT) Lovell, J. (CSIRO) Jauncey, D. (CSIRO) Preston, R. (JPL) Birkinshaw, M. (Bristol, UK) Worrall, D. (Bristol, UK) Schwartz, D. (CfA)	A sample of core dominated radio sources. 6, 20 cm

No.	Observer(s)	Programs
AM674	Mohan, R. N. (Raman Institute) Kurtz, S. (Mexico/UNAM) Anantharamaiah, K. (Raman Institute)	Extended emission around ultracompact H II regions. 6 cm
AM675	Molnar, L. (Iowa) Dunn, D. (UC, Berkeley)	High dynamic range mapping of Saturn at large ring inclination. 20 cm
AM679	Migenes, V. (Guanajuato U.) Coziol, R. (Guanajuato U.) Moellenbrock, G.	Confirmation of water megamasers in starburst galaxies. 1.3 cm
AN093	Natta, A. (Arcetri) Testi, L. (Arcetri) Wilner, D. (CfA) Shepherd, D.	Protoplanetary disks around intermediate mass PMS stars. 0.7, 3.6 cm
AN095	Neff, S. (NASA/GSFC) Ulvestad, J.	Star formation in merging galaxies: an age ordered sequence. 3.6, 6 cm
AN097	Nagar, N. (Maryland) Falcke, H. (MPIR, Bonn) Wilson, A. (Maryland)	The 20 cm to 850 micron spectral energy density in nearby galaxies. 0.7, 1.3, 3.6 cm
AO153	Olmi, L. (Massachusetts) Testi, L. (Arcetri) Shepherd, D. Cesaroni, R. (Arcetri)	OH masers in high mass star formation regions. 20 cm
AO156	Owen, F. Morrison, G. (IPAC) Small, I. (Durham) Ivison, R. (U. College London) Oemler, G. (Mt. Wilson) Dressler, A. (Mt. Wilson) Ledlow, M. (New Mexico)	Extremely deep survey of the CL 0939+47 field. 20 cm
AP395	Perlman, E. (STScI) Landt, H. (STScI) Padovani, P. (STScI)	X-ray bright flat spectrum radio quasars. 20 cm
AP405	Parma, P. (Bologna) Capetti, A. (Torino) de Ruiter, H. (Bologna) Fanti, R. (Bologna) Morganti, R. (NFRA)	An 8.4 GHz snapshot survey of B2 low luminosity radio galaxies. 3.6 cm

No.	Observer(s)	Programs
AP409	Perez-Torres, M. (Bologna) Alberdi, A. (IAA, Andalucia) Marcaide, J. (Valencia) Uson, J.	Synchrotron self-absorption in SN 1993J. 2, 3.6, 6, 20, 90 cm
AP417	de Pater, I. (UC, Berkeley) Dunn, D. (UC, Berkeley) Engel, C. (CSIRO) Sault, R. (CSIRO) Owen, T. (Hawaii) Atreya, S. (Michigan)	Observations of Jupiter during the Cassini-Jupiter Flyby. 3.6, 6 cm
AP418	Pihlstrom, Y. (Chalmers, Onsala) Conway, J. (Chalmers, Onsala)	HI absorption in FRI radio galaxies. 20 cm
AP420	Pedelty, J. (NASA/GSFC) Hollis, J. (NASA/GSFC)	Monitoring of the R Aquarii binary system's orbit and jet dynamics. 0.7 cm
AP423	Partridge, R. B. (Haverford College)	Transient source in the Lynx deep field. 3.6, 20 cm
AR435	Rudnick, L. (Minnesota) Koralsky, B. (Minnesota) Petre, R. (NASA/GSFC) Gotthelf, E. (Columbia) Holt, S. (NASA/GSFC)	Cas A: probing the X-ray/radio connections. 6 cm
AR440	Rudnick, L. (Minnesota) Young, A. (Minnesota) Makishima, K. (Tokyo U.) Tshiro, M. (Tokyo U.) Iyomoto, N. (Tokyo U.) Kassim, N. (NRL) Worrall, D. (Bristol, UK)	Radio lobe physics—radio spectra and inverse compton X-rays. 6, 20, 90 cm
AR441	Rudnick, L. (Minnesota) Young, A. (Minnesota) Kassim, N. (NRL) Slee, O. (CSIRO) Sarazin, C. (Virginia) Andernach, H. (Guanajuato U.) Roy, A. (MPIR, Bonn)	Cluster "relic" physics—spectral and X-ray studies. 90 cm
AR444	Rodriguez, L. (Mexico/UNAM) Anglada, G. (IAA, Andalucia) Torrelles, J. (IAA, Andalucia)	Testing the binary hypothesis for the FU Ori object V1057 Cyg. 3.6 cm

No.	Observer(s)	Programs
AR445	Rodriguez, L. (Mexico/UNAM) Wilner, D. (CfA) Ho, P. (CfA)	Young source IRAS 04386+2557. 0.7 cm
AR446	Reid, M. (CfA) Menten, K. (MPIR, Bonn)	Imaging the radio photospheres and dust forming zone in Miras. 0.7 cm
AR448	Reipurth, B. (Colorado/JILA) Rodriguez, L. (Mexico/UNAM) Anglada, G. (IAA, Andalucia) Bally, J. (Colorado/JILA)	Multiplicity and dynamical processes in early stellar evolution. 3.6 cm
AR451	Reid, M. (CfA) Menten, K. (MPIR, Bonn)	Locating SiO masers for an infrared position for Sgr A*. 0.7 cm
AS568	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (UCLA) Panagia, N. (STScI)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS697	Schoenmakers, A. (NFRA) Rottgering, H. (Leiden) de Bruyn, A. G. (NFRA) Kaiser, C. (MPIfEP, Garching)	Structure and formation of double-double radio galaxies. 3.6, 6, 20 cm
AS701	Sokoloski, J. (Southampton) Kaiser, C. (MPIfEP, Garching) Charles, P. (Southampton)	Symbiotic binaries during outburst. 3.6, 6, 20 cm
AT249	Taylor, G. Peck, A. (MPIR, Bonn) Giovannini, G. (Bologna)	Location and kinematics of the HI gas in 3C293. 6, 20 cm
AT250	Kardeshev, N. (Lebedev) Cheepashchuk, A. (Moscow/SSAI) Marshall, H. (MIT) Preston, R. (JPL) Slee, O. (CSIRO) Tingay, S. (CSIRO) Tsarevsky, G. (CSIRO)	Search for new galactic microquasars among ROSAT sources. 3.6, 6 cm

No.	Observer(s)	Programs
AT251	Thean, A. (Bologna) Pedlar, A. (Manchester) Gillibrand, T. (Manchester) Baum, S. (STScI) Kukula, M. (Edinburgh) O'Dea, C. (STScI)	Newly recognized Seyferts from the extended 12-micron sample. 3.6 cm
AT252	Tarchi, A. (Bonn U.) Neininger, N. (Bonn U.) Klein, U. (Bonn U.)	Compact sources in NGC 2146. 2, 3.6 cm
AT254	Tschager, W. (Leiden) Schilizzi, R. (NFRA) Perley, R. Rottgering, H. (Leiden) Snellen, I. (Cambridge) Miley, G. (Leiden)	New sample of faint compact steep-spectrum radio sources. 400 cm
AU084	Ulvestad, J.	NGC 7582 - black hole or supernova powered? 3.6, 6 cm
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm
AW530	Wrobel, J. Walker, R. C. Schwartz, C. (UC, Santa Barbara) Laing, R. (Oxford) Bridle, A.	Proper motions in the FRI radio galaxy M84. 6 cm
AW545	Wilner, D. (CfA) Ho, P. (CfA) Rodriguez, L. (Mexico/UNAM)	Nearby T Tauri stars. 0.7 cm
AW546	Williams, P. (Royal Obs) Dougherty, S. (DRAO)	Spectral energy distribution of WR 125. 3.6, 6, 20 cm
AY118	Yusef-Zadeh, F. (Northwestern) Bower, G. (UC, Berkeley)	Shock excited OH masers at the galactic center. 20 cm
AZ129	Zhao, J. (CfA) Bower, G. (UC, Berkeley) Goss, W. M. McGary, R. (CfA)	VLA monitoring Sgr A*. 0.7, 1.3, 2 cm

No.	Observer(s)	Programs
AZ130	Zebker, H. (Stanford) Harcke, L. (Stanford) Butler, B. Slade, M. (JPL) Jurgens, R. (JPL)	Goldstone/VLA radar observations of Ganymede and Callisto. 3.6 cm
BB125	Beasley, A. (OVRO) Claussen, M. Herrnstein, J. (Renaissance Tech)	Monitoring of WR140. 3.6, 6 cm
BB127	Blundell, K. (Oxford) Close, L. (Oxford)	Imaging of the hotspots in CSOs. 90 cm
BB129	Brogan, C. Claussen, M. Goss, W. M.	Zeeman observations of OH masers associated with SNRs. 18 cm
BC107	Cassaro, P. (Catania) Stanghellini, C. (Noto) Dallacasa, D. (Bologna) Bondi, M. (Bologna) Zappala, R. (Catania)	Observations of jets in blazars. 90 cm
BC110	Cotton, W. Spencer, R. (Manchester) Saikia, D.J. (NCRA-Pune) Garrington, S. (Manchester)	Search for jet deflecting. 18 cm
BD069	Diamond, P. (Manchester) Kemball, A.	TX Cam: the final curtain. 7 cm
BG098	Greenhill, L. (CfA) Diamond, P. (Manchester) Moran, J. (CfA)	Maser motions in Orion BN/KL. 7 cm
BG099	Gomez, J-L. (IAA, Andalucia) Augudo, I. (IAA, Andalucia) Marscher, A. (Boston) Marchenko, S. (Boston) Alberdi, A. (IAA, Andalucia) Garcia-Miro, C. (IAA, Andalucia) Cawthorne, T. (Lancashire)	Polarization of sources with compact stationary components. 2 cm

No.	Observer(s)	Programs
BG113	Gomez, J-L. (IAA, Andalucia) Marscher, A. (Boston) Marchenko-Jorstad, S. (Boston) Alberdi, A. (IAA, Andalucia) Agudo, I. (IAA, Andalucia) Marti, J.M. (U. Jaen) Aloy, M.A. (Valencia) Ibanez, J.M. (Valencia)	Monitoring superluminal components in 3C120. 2 cm
BH066	Hardcastle, M. (Bristol, UK) Worrall, D. (Bristol, UK) Birkinshaw, M. (Bristol, UK)	Hot spots of 3C123. 90 cm
BH075	Hagiwara, Y. (MPIR, Bonn) Diamond, P. (Manchester) Nakai, N. (NAO) Henkel, C. (MPIR, Bonn)	Nuclear water maser in NGC 5793. 1, 3 cm
BH076	Hollis, J. (GSFC) Boboltz, D. (USNO) Forster, J. (UC, Berkeley) Pedelty, J. (GSFC)	Searching for rotation in the SiO maser shells of five late-type stars. 7 cm
BK071	Kowatsch, P. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Roy, A. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Fricke, K. (Gottingen)	Two-sided jet in Seyfert 2 galaxy NGC 3079. 3.6, 6, 18 cm
BK073	Kellermann, K. Biretta, J. (STScI) Owen, F. Junor, W. (New Mexico)	Kinematics of parsec and subparsec structure of M87 jet. 2 cm
BL085	Lara, L. (IAA) Alberdi, A. (IAA)	Five daily snapshots on IDV 0917+624. 2 cm
BM138	Mutel, R. (Iowa) Ignace, R. (Iowa) Gayley, K. (Iowa)	Wolf-Rayet binaries WR 146 and WR 147. 21 cm
BP072	Palmer, P. (Chicago) Goss, W. M.	Observations of 2II J=1/2 OH in galactic sources. 6 cm

No.	Observer(s)	Programs
BP075	Patnaik, A. (MPIR, Bonn) Kemball, A.	Search for gravitational lensing in damped Ly systems. 2 cm
BR067	Ratner, M.I. (CfA) Bartel, N. (York U.) Bietenholz, M.F. (York U.) Lebach, D. (CfA) Lestrade, J.-F. (Meudon) Ransom, R. (York U.) Shapiro, I. (CfA)	Astronometry of IM Peg in 2000 for the gravity probe-b mission. 3.6 cm
BV040	Vlemmings, W. (Leiden) Baudry, A. (Bordeaux) Diamond, P. (Manchester) Habing, H. (Leiden) Schilizzi, R. (JIVE) van Langevelde, H. (JIVE)	Monitoring the amplified stellar image in 4 AGB stars. 18 cm
BW053	Winn, J. (MIT) Cohen, A. (NRL) Hewitt, J. (MIT)	Model constraints for a new flat spectrum gravitational lens. 3.6 cm
GB037	Browne, I. (Jodrell Bank) Jackson, N. (Jodrell Bank) Briggs, A. (Jodrell Bank) Mao, S. (Jodrell Bank) Wilkinson, P. (Jodrell Bank) Wucknitz, O. (Hamburg) Porcas, R.(MPIR, Bonn) Patnaik, A. (MPIR, Bonn)	Gravitational lens system B0218+35. 3.6 cm
GB038	Bartel, N. (York) Rupen, M. Beasley, A. (OVRO) Bietenholz, M. (York) Conway, J. (Onsala) Altunin, V. (JPL) Graham, D. (MPIR, Bonn) Venturi, T. (Bologna) Umana, G. (Noto)	SN 1993J and the core-jet in M81. 6, 13, 18 cm

No.	Observer(s)	Programs
GM040	Marcaide, J. (Valencia) Guirado, J. (Valencia) Beasley, A. (OVRO) Bietenholz, M. (York) Conway, J. (Onsala) Altunin, V. (JPL) Graham, D. (MPIR, Bonn) Venturi, T. (Bologna) Umana, G. (Noto)	Monitoring of the expansion of SN 1993J. 6, 18 cm
GO005	Owsianik, I. (MPIR, Bonn)	The study of inner jet in 3C326. 3.6 cm
GP028	Pihlstrom, Y. (Onsala) Conway, J. (Onsala) van Langevelde, H. (JIVE) Jaffe, W. (Leiden) Schilizzi, R. (JIVE)	HI absorbing gas in NGC 4261. 5 cm
W33OP	Kameno, S. (NAO)	GPS source J0905+48. 3.6 cm

VERY LONG BASELINE ARRAY OBSERVING PROGRAMS

The following research programs were conducted with the VLBA during this quarter:

No.	Observer(s)	Programs
BA041	Aller, H. (Michigan) Aller, M. (Michigan) Hughes, P. (Michigan) Wardle, J. (Brandeis) Homan, D. (Brandeis) Roberts, D. (Brandeis)	Sources with rapidly variable polarization. 0.7, 1.3, 2 cm
BA047	Asaki, Y. (ISAS) Deguchi, S. (Nobeyama) Honma, M. (Mizusawa) Imai, H. (Misusawa) Miyoshi, M. (Misusawa)	Determination of positions of a galactic evolved star with a distance of 2.3 kpc by phase-reference VLBI astronometry. 1 cm
BB122	Baudry, A. (Bordeaux) Diamond, P. (Manchester)	Second epoch observations of the 13.4 GHz OH maser in W3 (OH). 2 cm

No.	Observer(s)	Programs
BB125	Beasley, A. (OVRO) Claussen, M. Herrnstein, J. (Renaissance Tech)	Monitoring of WR140. 3.6, 6, 18 cm
BB126	Brisken, W. (Princeton) Benson, J. Fomalont, E. Goss, W. M. Thorsett, S. (UC, Santa Cruz)	Parallaxes of ten nearby radio pulsars. 18 cm
BB127	Blundell, K. (Oxford) Close, L. (Oxford)	Imaging of the hotspots in CSOs. 90 cm
BB129	Brogan, C. Claussen, M. Goss, W. M.	Zeeman observations of OH (1720 MHz) masers associated with SNRs. 20 cm
BB131	Britzen, S. (NFRA) Vermeulen, R. (NFRA) Taylor, G. Browne, I. (Manchester) Wilkinson, P. (Manchester) Pearson, T. (Caltech) Readhead, A. (Caltech)	Caltech-Jodrell snapshot survey of superluminal motion. 6 cm
BB134	Brisken, W. (Princeton) Golden, A. (NUI) Goss, W. M. Thorsett, S. (UC,Santa Cruz)	Parallax for PSR B0656+14. 20 cm
BC104	Chatterjee, S. (Cornell) Cordes, J. (Cornell) Goss, W. M. Fomalont, E. Beasley, A. J. (OVRO) Benson, J. Lazio, T. J. W. (NRL) Arzoumanian, Z. (NASA/GSFC)	High frequency VLBA pulsar astrometry. 6 cm
BC106	Coles, W. (UC, San Diego)	Measurements of the solar wind speed near the sun using IPS. 1.3, 2, 3.6, 6 cm

No.	Observer(s)	Programs
BC107	Cassaro, P. (Catania) Stanghellini, C. (Bologna) Dallacasa, D. (Bologna) Bondi, M. (Bologna) Zappala, R. (Catania)	Observations of jets in blazars. 90 cm
BC110	Cotton, W. Spencer, R. (Manchester) Saikia, D. (TIFR) Garrington, S. (Manchester)	Search for jet deflecting gas in 3C43 and 3C454. 18 cm
BD069	Diamond, P. (Manchester) Kemball, A.	TX Cam: the final curtain. 0.7 cm
BF060	Falcke, H. (MPIR, Bonn) Bower, G. (UC, Berkeley) Reid, M. (CfA)	Core shift in Sag A. 0.7, 1.3, 2 cm
BF062	Fuhrmann, L. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Cimo, G. (MPIR, Bonn) Kraus, A. (MPIR, Bonn) Witzel, A. (MPIR, Bonn)	Jet speeds of intraday variable sources. 6 cm
BF064	Fish, V. (CfA) Argon, A. (CfA) Menten, K. (MPIFR) Reid, M. (CfA)	Magnetic fields in masive star forming regions. 20 cm
BG098	Greenhill, L. (CfA) Diamond, P. (Manchester) Moran, J. (CfA)	Maser motions in Orion BN/KL. 0.7 cm
BG099	Gomez, J-L. (IAA, Andalucia) Agudo, I. (IAA, Andalucia) Marscher, A. (Boston) Marchenko, S. (Boston) Alberdi, A. (IAA, Andalucia) Garcia-Miro, C. (IAA, Andalucia) Cawthorne, T. (Lancashire)	Polarization of sources with compact stationary components. 0.7, 1.3, 2 cm

No.	Observer(s)	Programs
BG110	Gallimore, J. Baum, S. (STScI) Kukula, M. (Edinburgh) Murray, C. (UNM) O'Dea, C. (STScI) Pedlar, A. (Jodrell Bank) Thean, A. (Bologna)	Observations of CfA Seyferts. 13 cm
BG111	Gallimore, J. (Bucknell)	Possible new radio supernova in the merger remnant NGC 6240. 13 cm
BG112	Gallimore, J. (Bucknell)	Jet proper motions in Seyfert galaxies. 13 cm
BG113	Gomez, J-L. (IAA, Andalucia) Marscher, A. (Boston) Marchenko-Jorstad, S. (Boston) Alberdi, A. (IAA, Andalucia) Agudo, I. (IAA, Andalucia) Marti, J. (Jaen) Aloy, M. (Valencia) Ibanez, J. (Valencia)	Monitoring superluminal components in 3C120. 0.7, 1.3, 2 cm
BH066	Hardcastle, M. (Bristol, UK) Worrall, D. (Bristol, UK) Birkinshaw, M. (Bristol, UK)	Hot spots of 3C123. 90 cm
BH069	Hachisuka, K. (NAO) Fujisawa, K. (NAO) Honma, M. (NAO) Imai, H. (NAO) Kameya, O. (NAO) Kawaguchi, N. (NAO) Manabe, S. (NAO) Miyoshi, M. (NAO) Nishio, M. (NAO) Omodaka, T. (NAO) Sasao, T. (NAO) Sawada-Satoh, S. (NAO)	Determination of the velocity of Galactic rotation at IRAS 21008+4700. 1 cm
BH075	Hagiwara, Y. (MPIR, Bonn) Diamond, P. (Manchester) Nakai, N. (NAO, Japan) Henkel, C. (MPIR, Bonn)	Nuclear water maser in NGC 5793. 1.3 cm

No.	Observer(s)	Programs
BH076	Hollis, J. (NASA/GSFC) Pedelty, J. (NASA/GSFC) Boboltz, D. (USNO) Forster, J. (UC, Berkeley) White, S. (Maryland)	The SiO maser shells of late-type stars. 0.7 cm
BJ032	Johnston, K. (USNO) Fey, A. (USNO) Gaume, R. (USNO) Clark, T. (NASA/GSFC) Ma, C. (NASA/GSFC) Eubanks, T. M. (USNO) Kingham, K. (USNO) Boboltz, D. (USNO) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) Shaffer, D. (Radiometrics) Gordon, D. (NASA/GSFC) Fomalont, E. Walker, R. C.	Geodesy/astrometry observations for 2000. 3.6 cm
BK068	Kellermann, K. Winn, J. (MIT) Cohen, A. (MIT) Cohen, M. (Caltech) Hewitt, J. (MIT) Vermeulen, R. (NFRA) Zensus, J. A. (MPIfR)	Kinematics of quasars and AGN. 2 cm
BK071	Kowatsch, P. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Roy, A. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Fricke, K. (Gottingen)	Two-sided jet in Seyfert 2 galaxy NGC 3079. 3.6, 6, 18 cm
BK073	Kellermann, K. Biretta, J. (STScI) Owen, F. Junor, W. (New Mexico)	Kinematics of parsec and subparsec structure of M87 jet. 2 cm
BL085	Lara, L. (IAA, Andalucia) Alberdi, A. (IAA, Andalucia)	Five daily snapshots on IDV 0917+624. 1.3, 2 cm

No.	Observer(s)	Programs
BL091	Liszt, H. Lucas, R. (IRAM)	Molecular and atomic absorption in the galactic ISM. 20 cm
BM135	Monnier, J. (CfA) Danchi, W. (GSFC) Greenhill, L. (CfA) Tuthill, P. (Sydney)	When winds collide: imaging the shock interface in the WR + OB binary WR 112. 6 cm
BM136	Marscher, A. (Boston) Cawthorne, T. (Lancashire) Stirling, A. (Lancashire) Gear, W. (Wales) Stevens, J. (Cambridge) Marchenko, S. (Boston) Lister, M. (JPL) Gabuzda, D. (NFRA) Gomez, J-L. (IAA, Andalucia) Smith, P. (KPNO-NOAO) Forster, J. (UC, Berkeley) Yurchenko, A. (St. Petersburg)	Bright millimeter sources. 0.7 cm
BM138	Mutel, R. (Iowa) Ignace, R. (Iowa) Gayley, K. (Iowa)	Wolf-Rayet binaries WR 146 and WR 147. 3.6, 18 cm
BM139	Minnier, V. (Onsala) Booth, R. (Onsala) Ellingsen, S. (Tasmania) Norris, R. (ATNF)	Proper motion studies of 12.2 GHz methanol masers. 2 cm
BM143	Margot, J-L. (NAIC) Campbell, D. (Cornell) Slade, M. (JPL) Jurgens, R. (JPL)	Bistatic radar observations of the lunar south pole. 13 cm
BP072	Palmer, P. (Chicago) Goss, W. M.	Observations of II J=1/2 OH in galactic sources. 6 cm
BP075	Patnaik, A. (MPIR, Bonn) Kemball, A.	Search for gravitational lensing in damped Ly systems. 2, 4 cm

No.	Observer(s)	Programs
BP076	Phillips, P. (Jodrell Bank) Browne, I. (Jodrell Bank) Myers, S. Norbury, M. (Jodrell Bank) Rusin, D. (Pennsylvania) Wilkinson, P. (Jodrell Bank)	Long track observations of a CLASS lens and lens candidate. 6 cm
BR067	Ratner, M. (CfA) Bartel, N. (York U.) Bietenholz, M. (York U.) Lebach, D. (CfA) Lestrade, J-F. (Paris Obs) Ransom, R. (York U.) Shapiro, I. (CfA)	Astronometry of IM Peg in 2000 for the gravity probe-b mission. 2, 3.6, 6 cm
BV040	Vlemmings, W. (Leiden) Baudry, A. (Bordeaux) Diamond, P. (Jodrell Bank) Habing, H. (Leiden) Schilizzi, R. (JIVE) van Langevelde, H. (JIVE)	Monitoring the amplified stellar image in four AGB stars. 20 cm
BV042	Venturi, T. (Bologna) Dallacasa, D. (Bologna) Mantovani, F. (Bologna)	Second epoch monitoring of gamma-ray loud blazars. 1, 4 cm
BW053	Winn, J. (MIT) Cohen, A. (MIT) Hewitt, J. (MIT)	Model constraints for a new flat-spectrum gravitational lens. 4, 20 cm
GB037	Browne, I. (Manchester) Jackson, N. (Manchester) Biggs, A. (Manchester) Mao, S. (Manchester) Wilkinson, P. (Manchester) Wucknitz, O. (Hamburg U.) Porcas, R. (MPIR, Bonn) Patnaik, A. (MPIR, Bonn)	Gravitational lens system B0218+35. 3.6 cm

No.	Observer(s)	Programs
GB038	Bartel, N. (York U.) Rupen, M. Beasley, A. (OVRO) Bietenholz, M. (York U.) Conway, J. (Chalmers, Onsala) Altunin, V. (JPL) Graham, D. (MPIR, Bonn) Venturi, T. (Bologna) Umana, G. (Bologna)	SN1993J and the core-jet in M81. 3.6, 6, 18 cm
GM040	Marcaide, J. (Valencia) Guirado, J. (Valencia) Alberdi, A. (IAA, Andalucia) Lara, L. (IAA, Andalucia) Ros, E. (MPIR, Bonn) Diamond, P. (Manchester) Shapiro, I. (CfA) Preston, R. (JPL) Schilizzi, R. (NFRA) Mantovani, F. (Bologna) Perez-Torres, M. (Bologna) Trigilio, C. (Bologna) Van Dyk, S. (IPAC) Weiler, K. (NRL) Sramek, R. Whitney, A. (Haystack)	Monitoring of the expansion of SN 1993J. 6, 18 cm
GM043	Moscadelli, L. (Bologna) Cesaroni, R. (Arcetri) Rioja, M. (Yebes Obs)	Water masers in high-mass protostar IRAS 20126+4104. 1.3 cm
GO005	Owsianik, I. (MPIR, Bonn) Peck, A. (MPIR, Bonn) Schilizzi, R. (NFRA) Taylor, G. Conway, J. (Chalmers, Onsala)	The study of inner jet in 3C236. 6, 18 cm
GP028	Pihlstrom, Y. (Chalmers, Onsala) Conway, J. (Chalmers, Onsala) van Langevelde, H. (NFRA) Jaffe, W. (Leiden) Schilizzi, R. (NFRA)	HI absorbing gas in NGC 4261. 18 cm
V030	Preston, R. (JPL)	Pearson-Readhead survey from space. 6 cm

No.	Observer(s)	Programs
V047	Gurvits, L. (NFRA)	Structure of extremely high redshift quasars at 1.6 and 5 GHz. 18 cm
V053	Witzel, A. (MPIR, Bonn)	Polarization variability of intraday variable sources. 6 cm
W009	Linfield, R. (JPL) Ulvestad, J.	The most compact TDRSS Sources: J1924-2914 and J2218-0335. 6, 18 cm
W022	Reid, M. (CfA) Greenhill, L. (CfA) Argon, A. (CfA) Moran, J. (CfA)	Nuclear jet in M87. 18 cm
W023	Jones, D. (JPL) Wehrle, A. (JPL)	NGC 4261. 18 cm
W035	Gurvits, L. (NFRA) Frey, S. (FOMISGO) Schilizzi, R. (NFRA) Kellermann, K. Lobanov, A. (MPIR, Bonn) Moran, E. (UC, Berkeley) Laurent-Muehleisen, S. (UC, Davis) Pauliny-Toth, I. (MPIR, Bonn)	Structure of extremely high redshifted quasars. 6 cm
W040	Junor, B. (New Mexico) Biretta, J. (STScI)	Proper motion in the Vir A jet. 6 cm
W050	Porcas, R. (MPIR, Bonn) Zensus, J. (MPIR, Bonn) Hough, D. (Trinity U.)	Cores of lobe-dominated quasars—Epoch 2. 6 cm
W052	Rioja, M. (Yebes Obs) Porcas, R. (MPIR, Bonn)	Astrometry on the quasars 1038+52A, B. 6 cm
W068	Zensus, J. A. (MPIR, Bonn) Carrara, E. (Sao Paulo) Abraham, Z. (Sao Paulo) Lobanov, A. (MPIR, Bonn) Unwin, S. (JPL)	Quasar 3C 273. 6 cm

No.	Observer(s)	Programs
W088	Roberts, D. (Brandeis) Moellenbrock, G. Wardle, J. (Brandeis) Gabuzda, D. (NFRA) Brown, L. (Connecticut)	Polarization monitoring of four bright quasars at 5 and 1.6 GHz. 18 cm
W312	Preston, R. (JPL) Pearson, T. (Caltech) Readhead, A. (Caltech) Lister, M. (JPL) Piner, B. (JPL) Tingay, S. (CSIRO) Hirabayashi, H. (ISAS, Japan) Kobayashi, H. (NAO, Japan) Inoue, M. (NAO, Japan)	Completing the Pearson-Readhead survey from space. 6 cm
W330	Kameno, S. (NAO, Japan) Wajima, K. (ISAS, Japan) Zhi-Qiang, S. (NAO, Japan) Inoue, M. (NAO, Japan) Sawada-Satoh, S. (NAO, Japan)	Complementary multi-frequency GPS survey. 6 cm
W331	Kameno, S. (NAO, Japan) Wajima, K. (ISAS, Japan) Zhi-Qiang, S. (NAO, Japan) Inoue, M. (NAO, Japan) Sawada-Satoh, S. (NAO, Japan)	Complementary multi-frequency GPS survey. 6 cm

PERSONNEL

New Hires

Barnes, Zachariah	Electronics Engineer III	11/29/00
D'Angio, Robert	Human Resources Mgr	10/16/00
Schmitt, Henrique	Research Associate	11/20/00

Terminations

Beasely, Anthony	Assoc Sci-Asst Dir Prog Dvlpmt-Res	11/30/00
Fassnacht, Christopher	Research Associate-End of Appt	11/14/00
Goldman, Michael	Res Engineer-End of Appt	12/31/00
Miller, Neal	Junior Research Associate-End of Appt	12/15/00
Verheijen, Marcus	Research Associate-End of Appt	11/20/00

Promotions

Prestage, Richard	to Assoc Sci-Head Comp	10/02/00

Transfers

Greisen, Eric	from Charlottesville to Socorro	10/01/00

PUBLICATIONS

Attached is a listing of all preprints received in the NRAO Charlottesville library during the reporting period authored by NRAO staff or based on observations on NRAO telescopes.

PREPRINTS RECEIVED, OCTOBER - DECEMBER 2000

AYRES, T.R.; BROWN, A.; OSTEN, R.A.; HUENEMOERDER, D.P.; DRAKE, J.J.; BRICKHOUSE, N.S.; LINSKY, J.L. Chandra, EUVE, Hubble, and VLA Multi-wavelength Campaign on HR 1099: Instrumental Capabilities, Data Reduction, and Initial Results.

BERGER, E.; BALL, S.; BECKER, K.M.; CLARKE, M.; FRAIL, D.A.; FUKUDA, T.A.; HOFFMAN, I.M.; KULKARNI, S.R.; MELLON, R.; MOMJIAN, E.; MURPHY, N.W.; TENG, S.H.; WOODRUFF, T.; ZAUDERER, B.A.; ZAVALA, R. Discovery of Radio Emission from the Brown Dwarf LP944-20.

BIGGS, A.D.; BROWNE, I.W.A.; MUXLOW, T.W.B.; WILKINSON, P.N. MERLIN/VLA Imaging of the Gravitational Lens System B0218+357.

BOBOLTZ, D.A.; MARVEL, K.B. Rotation in the Envelope of an Evolved Star: Observations of the SiO Masers Toward NML Cygni.

BROGAN, C.L.; TROLAND, T.H. VLA H I Zeeman Observations toward the W49 Complex.

CHATTERJEE, S.; CORDES, J.M.; LAZIO, T.J.W.; GOSS, W.M.; FOMALONT, E.B.; BENSON, J.M. Parallax and Kinematics of PSR B0919+06 from VLBA Astrometry and Interstellar Scintillometry.

CLARKE, T.E.; KRONBERG, P.P.; BOHRINGER, H. A New Radio - X-ray Probe of Galaxy Cluster Magnetic Fields.

COHEN, A.S.; HEWITT, J.N.; MOORE, C.B.; HAARSMA, D.B. Further Investigation of the Time Delay, Magnification Ratios, and Variability in the Gravitational Lens 0218+357.

CONDON, J.J.; YIN, Q.F. Offset Pointing Calibrators for Large Radio Telescopes.

COX, A.L.; SPARKE, L.S.; WATSON, A.M.; VAN MOORSEL, G. Stars & Gas in the Galaxy Pair II Zw 70/71.

DAS, M.; ANANTHARAMAIAH, K.R.; YUN, M.S. The Central Velocity Field in NGC 253 : Possible Indication of a Bar.

ERICKSON, W.C.; PERLEY, R.A.; FLATTERS, C.; KASSIM, N.E. Ionospheric Corrections for VLA Observations Using Local GPS Data.

FABIAN, A.C.; SANDERS, J.S.; ETTORI, S.; TAYLOR, G.B.; ET AL Chandra Imaging of the Complex X-ray Core of the Perseus Cluster.

GAO, Y.; LO, K.Y.; LEE, S.-W.; LEE, T.-H. Molecular Gas and the Modest Star Formation Efficiency in the 'Antennae' Galaxies: Arp 244=NGC 4038/39.

GRAY, R.H.; MARVEL, K.B. A VLA Search for the Ohio State 'Wow'

HOMAN, D.C.; OJHA, R.; WARDLE, J.F.C.; ROBERTS, D.H.; ALLER, M.F.; ALLER, H.D.; HUGHES, P.A. Parsec-Scale Blazar Monitoring: Proper Motions.

IGUCHI, S.; FUJISAWA, K.; KAMENO, S.; INOUE, M.; SHEN, Z.Q.; HIROTANI, K.; MIYOSHI, M. Multi-frequency VLBI Observations of OT 081.

KAMENO, S.; INOUE, M.; FUJISAWA, K.; SHEN, Z.Q.; WAJIMA, K. First-Epoch VSOP Observations of 3C 380: Kinematics of the Parsec-Scale Jet.

LEHAR, J.; BUCHALTER, A.; MCMAHON, R.G.; KOCHANEK, C.S.; MUXLOW, T.W.B. An Efficient Search for Gravitationally-Lensed Radio Lobes.

LOBANOV, A.P.; GURVITS, L.I.; FREY, S.; SCHILIZZI, R.T.; KELLERMANN, K.I.; KAWAGUCHI, N.; PAULINY-TOTH, I.I.K. VSOP Observation of the Quasar PKS 2215+020: A New Laboratory for Core-Jet Physics at z = 3.572.

LOBANOV, A.P.; KRICHBAUM, T.P.; GRAHAM, D.A.; WITZEL, A.; KRAUS, A.; ZENSUS, J.A.; BRITZEN, S.; GREVE, A.; GREWING, M. 86 GHz VLBI Survey of Compact Radio Sources.

LOCKMAN, F.J.; MINTER, A.H. A Unique Giant HI Cloud in the Inner Galaxy.

LUCAS, P.W.; BLUNDELL, K.M.; ROCHE, P.F. A High-Resolution Radio Survey of Class 1 Protostars.

MARR, J.M.; TAYLOR, G.B.; CRAWFORD, F. Non-uniform Free-Free Absorption in the GPS Radio Galaxy 0108+388.

PREPRINTS RECEIVED, OCTOBER - DECEMBER 2000

PHILLIPS, P.M.; BROWNE, I.W.A.; WILKINSON, P.N. ARCS, The Arcminute Radio Cluster-Lens Search - I. Selection Criteria and Initial Results.

PHILLIPS, P.M.; NORBURY, M.; KOOPMANS, L.; BROWNE, I.; JACKSON, N.; WILKINSON, P.N.; BIGGS, A.; BLANDFORD, R.D.; DE BRUYN, A.G.; FASSNACHT, C.D.; HELBIG, P.; MAO, S.; MARLOW, D.R.; MYERS, S.T.; PEARSON, T.J.; READHEAD, A.C.S.; RUSIN, D.; XANTHOPOULOS, E. A New Quadruple Gravitational Lens System: CLASS B0218+437.

PUSTILNIK, S.A.; BRINKS, E.; THUAN, T.X.; LIPOVETSKY, V.A.; IZOTOV, Y.I. VLA HI Line Observations of the Extremely Metal-Poor Blue Compact Dwarf Galaxy SBS 0335-052.

ROSHI, D.A.; ANANTHARAMAIAH, K.R. Hydrogen Recombination Lines Near 327 MHz - III : Physical Properties and Origin of the Low-Density Ionized Gas in the Inner Galaxy.

SANDELL, G.; KNEE, L.B.G. NGC 1333 - Protostars, Dust Shells, and Triggered Star Formation.

SANDELL, G.; WEINTRAUB, D.A. On the Similarity of FU Orionis Stars to Class I Protostars: Evidence from the Submillimeter.

SMITH, B.J.; STRUCK, C. New Observations of Extra-Disk Molecular Gas in Interacting Galaxy Systems, Including a Two-Component System in Stephan's Quintet.

SUBRAHMANYAN, R.; GOSS, W.M.; MALIN, D.F. Radio Continuum Structure of the Orion Nebula.

THILKER, D.A. Properties of H I in M 31 and M 33.

THILKER, D.A.; BRAUN, R.; WALTERBOS, R.A.M. HIIphot: Automated Photometry of H II Regions Applied to M51.

TULLMANN, R.; DETTMAR, R.-J.; SOIDA, M.; URBANIK, M.; ROSSA, J. The Thermal and Non-thermal Gaseous Halo of NGC 5775.

VERHEIJEN, M.A.W.; SANCISI, R. The Ursa Major Cluster of Galaxies. IV. H I Synthesis Observations.

XU, C.; BAUM, S.A.; O'DEA, C.P.; WROBEL, J.M.; CONDON, J.J. VLBA Observations of a Sample of Nearby FR I Radio Galaxies.

YUN, M.S.; HIBBARD, J.E. Molecular Gas in Optically Selected Mergers.

ZHAO, J.-H.; BOWER, G.C.; GOSS, W.M. Radio Variability of Sagittarius A* - A 106 Day Cycle.