Quarterly Report
January - March 2001

National Radio
Astronomy
Observatory

A facility of the National
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NRAO

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Science Highlights

Green Bank Telescope

The GBT's first new, scientific observations were successfully conducted on March 24-26. The observations were bi-static radar observations of Venus and a close-passing asteroid, done in participation with Arecibo. In this project, S-band delay Doppler radar signals were transmitted for five minutes (the light travel time to Venus) by Arecibo. Both the GBT and Arecibo then received the return echo for the same period, and the cycle was thus repeated. The fast sampling back-ends were provided by the research team. The scientific objective of the project was to image high reflectivity areas of Maxwell Montes and Beta Regio. The GBT/Arecibo system will provide altimetry measurements at a spatial resolution about 5-15 times better than that of the 1990 Magellan orbiter mission. Imaging information comes from a combination of the delay Doppler echo and interferometric fringes between Arecibo and the GBT. Venus was at inferior conjunction for the observations and it was thus an ideal time for the observations. The north-south baseline between Arecibo and the GBT aligned with the spin axis of Venus, which will allow best interpretation of the radar echos. In addition to the Venus observations, radar images of a close-passing asteroid, 2001 EC 16, were also made. This asteroid was discovered only two weeks prior to the observations, and was passing by Earth at about eight times the Earth-Moon distance.

Investigators: *D. Campbell (Cornell), J.-L.Margot (Caltech), L. Carter (Cornell), B. Campbell (Smithsonian Institution).*

Very Large Array

VLA-Pie Town Link Reveals Accretion Disk of Massive Young Star - Using the VLA-Pie Town link, observers were able to detect a solar-system-sized accretion disk around the young stellar object G192.16-3.82. This object powers one of the largest stellar outflows in the Galaxy. The accretion disk found around this 8-10 solar-mass object contains about 20 solar masses. In addition to revealing the inner accretion disk, the VLA showed the inner portion of the outflow and also revealed that the young star has a companion. This is the first time an inner accretion disk has been observed around a massive young star.

Investigators: *D. Shepherd, M. Claussen (NRAO) and S. Kurtz (UNAM).*

Summer-Student Project Discovers Radio Emission from Brown Dwarf - The VLA summer students for 2000 used some of their student project VLA observing time on the brown dwarf LP944-20, though no radio emission had ever been detected from a brown dwarf. Luckily, the object flared during their observation, giving them the first-ever detection of radio emission from a brown dwarf. The emission measured by the VLA

was 10,000 times stronger than expected from such an object. Subsequently receiving more observing time, the student team detected two more flares. Their results were published in the March 15 issue of *Nature*.

Investigators: *E. Berger (Caltech), S. Ball (NMT), M. Clarke (Carleton College), T. Fukuda (U Denver), I. Hoffman (UNM), R. Mellon (Penn State), E. Momjian (Kentucky), N. Murphy (Amherst), S. Teng (U Maryland), T. Woodruff (Southwestern University), A. Zauderer (Agnes Scott), and D. Frail (NRAO).*

VLBA Reveals Time Variable Rotation Measures in Quasar Cores - Using the VLBA, observers have demonstrated for the first time that the Faraday Rotation Measures (RMs) in the nuclei of the quasars 3C273 and 3C279 change significantly on time scales of months. This discovery was made possible by the very high angular resolution, frequency agility, and good polarization characteristics of the VLBA. Previous, lower resolution, observations were dominated by the emission from the less variable jet components far removed from the central engine. The observed variations can tell us about the magnetic fields and density in the immediate environment of the central engine in quasars. These results are now in press at the Astrophysical Journal Letters.

Investigators: *R.T. Zavala (NRAO/NMSU) and G. Taylor (NRAO).*

The ALMA project has made important progress during the current period. 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
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		03/01/01
4.25.05	PDR: Front-end Subsystem	11/01/00	02/16/01	02/16/01
7.10.30	Deliver Test Correlator to ALMA Test	03/01/01	02/15/01	02/15/01
8.03.30.25	CDR: Control Software	03/01/01		03/01/01
10.17	CDR: ALMA Configurations	03/01/01	02/26/01	02/26/01
5.10.10.15	Deliver Prototype 80-240 GHz Tripler	05/01/01	06/01/01	
1.05.22	Review: ALMA Management Advisory Committee	06/01/01	06/08/01	
6.05.16	Back-end Subsystem CDR	06/01/01		
8.03.05.30	Deliver Phase 2 Computing Plan	06/01/01		
9.12.35	Test Interferometer Test Site Complete	06/01/01		

As described last period, 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 has been delivered. 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 PDR for the front-end was held in Tucson in February. This comprehensive two day review covered the design of the complete front-end subsystem including optics, frequency cartridge design, cryogenics and interfaces to other ALMA subsystems.

The Test Correlator has been delivered to Socorro. The Test Correlator will be outfitted for use in the test interferometer.

A Configuration CDR was held in February in Grenoble. This review covered the placement of the 64 antennas of the baseline array for the various configurations.

The delivery of a prototype tripler has been delayed due to fabrication problems with the varactor diodes used in the tripler. This tripler is planned to be used in the evaluation receivers. Should this prototype not be available in time for inclusion with the evaluation receivers, a commercial tripler with performance adequate for the evaluation receiver is available.

Other Significant Accomplishments

Programmatic

The Millimeter Array Oversight Committee (MMAOC), a panel charged by the NSF to review progress and planning for the U.S. portion of ALMA (formerly the MMA Project), met at the NSF in February. Based on the detailed two-day review, the committee concluded that "the ALMA project is ready to start construction and we recommend that NSF approve ALMA to move to Phase II. The ALMA team is more than ready for ALMA construction."

The committee further noted:

> The project has made impressive technical progress and is meeting the goals for Phase I ... NRAO is to be commended for remarkable technical and managerial progress. They have initiated implementation of all of the recommendations we requested at our last meeting, and moved the project from a scientific dream to a realistic plan for an observatory ... NRAO has made rapid progress in all areas, including technical tasks, project management, and also international coordination ... they have succeeded admirably in the Design and Development Phase (Phase I).

Key accomplishments of the ALMA team include:

- Completion of the Work Breakdown Structure (WBS) enumerating all tasks for the project,
- Completion of the budget organized according to the WBS,
- Completion of a schedule leading to full deployment in 2009,
- Completion of an international plan allocating work elements to the U.S. and Europe,
- Establishment of an Earned Value System, showing progress along the plan and calculating the performance for both cost and schedule,
- Awarding contracts (one NRAO, one ESO) for antenna prototypes, for delivery late this year,
- Production of advanced cryogenically cooled receivers, meeting the specifications for ALMA,
- Design of a suitable correlator chip, which meets the ALMA requirements

Technical

An OSF site location between Array Site and San Pedro is under study that can provide a direct link between the OSF and the Array Site. Additionally, an Environmental Impact Study has been completed for the facilities in Chile.

The U.S. antenna contractor, Vertex, has begun fabrication of the prototype antenna. All major components are currently on order and tooling is in process. The delivery schedule for the antenna is under

review. Vertex has advised the project that delivery is likely to slip as much as three months. Vertex has agreed to consider remedial actions that could recover some or all of the slip. These include multiple BUS molds, a second CFRP fabricator and a second panel supplier.

A Preliminary Design Review was held for the Front-end Subsystem in February. The review committee approved the overall design concepts presented for the vacuum vessel, cryogenics, cartridge layout and optics. Some concerns were expressed about the schedule and resources available for front-end development. These concerns are being reviewed and a more detailed front-end development plan is being constructed to address these concerns

The design of the custom correlator chip is complete. Detailed simulations of the logical and dynamic performance have been successfully completed. Fabrication of prototype quantities will begin this spring with deliveries expected this summer.

The layout of the Test Interferometer Site is complete. Grading of the site has been completed and installation of the electrical power distribution system is underway. Site preparations will be completed early this summer.

During this quarter, seventeen new ALMA Memos were added to the series bringing the total number to 359. The ALMA Memo Series is available at http://www.nrao.edu/almamirror/memos/.

Outfitting

Milestone	Original Date	Revised Date	Date Completed
Measure K-band feeds	07-03-00	01-29-01	01-29-01
Assemble all cryo. components	07-14-00	06-30-01	
Install lower feed arm lasers	09-15-00	04-30-01	
Install perimeter fence	11-17-00	04-06-01	04-06-01
Complete Q-band tertiary	04-15-00	12-30-01	
Measure az track profile	09-15-99	06-30-01	
Reposition reflector surface	04-30-01		
Reset surface panel corners	05-31-01		
Install optical guide scope	04-30-01		
Replace az wheel bearings	05-31-01		

GBT Electronics Development

Milestone	Original Date	Revised Date	Date Completed
Q-band Receiver available for use	12-31-00	10-01-01	
Active Surface / M&C integration & testing	02-28-01	09-30-01	
GBT new compressors & cryo system	07-14-00	06-30-01	

Mechanical Engineering and NRAO Central Instrument Shop

Milestone	Original Date	Revised Date	Date Completed
Install GBT spillover shield	01-24-01	04-20-01	
Install GBT holography reference horn	02-07-01		02-15-01
Fab. GBT tachometer covers	02-28-01		03-15-01
Fab. mount for GBT optical guide telescope	02-28-01		03-29-01
Install mount for GBT optical telescope	04-27-01		
Fab. and install GBT safety equipment	04-30-01		

GBT Software and Computing

Milestone	Original Date	Revised Date	Date Completed
Release M&C Version 3.2.0	01-12-01	01-19-01	01-19-01
Complete antenna servo tests	01-19-01	02-02-01	02-02-01
Spectrometer basic spectral line modes available	03-16-01	05-31-01	
M&C / VLBA software integration	01-19-01	07-31-01	
Observer (GO) interface completion	03-23-01	06-30-01	
Optical pointing telescope development and installation	02-02-01	04-30-01	
Prepare for visiting observers	06-30-01		
Complete Doppler tracking capability	06-30-01		
Unify GBT FITS file formats	06-30-01		

GBT Operations

Milestone	Original Date	Revised Date	Date Completed
Operator training on most essential GBT systems	03-31-01		03-31-01
Commence GBT Programmed Maintenance	01-30-01		01-30-01
Operations of GBT from GBT Servo Room	02-01-01		02-05-01
Operations documentation templates available	03-01-01		03-31-01
Use of MainSaver by Telescope Operations	06-01-01		
First test of azimuth wheel bearing grease	06-30-01		
Plan for six months structural inspection of GBT	07-30-01		

GBT Project Summary

Telescope Commissioning

Commissioning observations for the GBT began on the evening of February 5 by pointing and focusing the telescope with the prime focus receiver at a frequency of 800 MHz. By February 23, the GBT

commissioning team had completed most of its prime focus work, and turned its attention to commissioning observations with the subreflector and S-band receiver at 2 GHz.

The preliminary results from the commissioning observations indicate that the GBT is performing as expected at these frequencies. In the absence of a pointing model, local pointing corrections at both 800 MHz and 2 GHz do not vary by more than ± 2 arcminutes over the range of azimuths and elevations where observations were made. The results from the prime focus observations show that the pointing curves are smooth, predictable, and repeatable, and that the residual pointing errors may be no larger than 8 arcseconds rms in each of azimuth and elevation. The first observations with the S-band receiver showed that the aperture efficiency of the telescope is approximately 70%, the system temperature is about 20 K, and the first sidelobes are about 30 dB down from the main beam. These encouraging results indicate that the optical alignment of the telescope is very good. The commissioning observations have also demonstrated that the software written for tracking, pointing, focusing, and mapping observations is working very well.

The initial S-band observations concentrated on accurately positioning the GBT subreflector. Although the subreflector positioning system has six degrees of the freedom, the primary motion of the GBT focal point occurs along the subreflector X and Y axes, which are elevation dependent primarily because of the gravitational flexure of the telescope feed arm. Observations were made to empirically determine the elevation dependent focal point, and the resulting focus tracking model was incorporated into the telescope monitor and control software.

The first all-sky pointing observation of the GBT using automatic focus tracking and refraction correction was made on March 9-10 at 2 GHz. After fitting the data to a traditional pointing model that consists of eight physical terms, the all-sky residual pointing error of the telescope was found to be 8.5 arcseconds rms. The pointing model is now incorporated into the telescope's monitor and control system for automatic pointing corrections.

Time domain reflectometry was used to search for standing waves caused by components of the GBT structure. Reflections corresponding to the distance between the top of the receiver room and the subreflector (15 meters) were detected. The reflections will manifest themselves as a 10 MHz standing wave in GBT spectral line observations. The strength of these reflections is about 20 dB below those initially recorded on the 140 Foot Telescope. Reflections from the GBT primary surface were not detected.

First Science Observations

The first scientific observations for the GBT were successfully conducted on March 24-26. The observations used bistatic S-band radar to image regions of Venus and a close-passing asteroid (2001 EC 16). The observations are described in more detail in the Science Highlights section of this report. The observations demonstrated the ability of the telescope's monitor and control software to accurately track a solar system object.

Telescope Outfitting

Outfitting activities continue on the telescope. Operational telephones were installed in the receiver, servo, and actuator control rooms. Computer workstations were installed in the servo room so that commissioning activities could be conducted from there. The reference horn for the holography receiver was installed at the top of the telescope feed arm. Conduit and cable trays for the lower feed arm lasers were installed, and the routing of cables to the lasers is now essentially complete. The lasers will be installed after these cables are terminated. The spillover shield was modified to accommodate a clearance problem with the subreflector. A new cryogenic compressor was completed and tested in the cryogenics laboratory. A number of safety enhancements are also being made on the telescope. A fence was installed around the perimeter of the GBT site.

Active Surface System

Tests of the active surface system revealed that 25 of the 2209 actuator motors had seized because of water seeping into the motor housings. These motors will be repaired, and all actuator motors need to be resealed.

Rangefinder Measurements of the GBT Structure

Experiments were made to test the ability of the ground laser rangefinders to automatically acquire targets on the structure at different orientations of the telescope. The rangefinders used the structural model of the telescope and readings from the azimuth and elevation encoders to perform the experiment. An experiment conducted on March 14 showed that all 12 ground laser rangefinders could measure ranges to all spherical retroreflectors on the structure.

Azimuth Track

Measurements of the azimuth track showed that the track wear strips and base plates move in the direction of telescope motion. A single wear strip can move by as much as one-eighth of an inch after the four wheels in an azimuth wheel truck pass over it. However, additional experiments showed that the motion of the base plates could be constrained by welding consecutive base plates to the splice plates that are secured in the concrete foundation. The welding of the track base plates was completed during the week of March 12.

Lockheed Martin (LM) attempted to secure an azimuth track wear strip to a baseplate by installing two, 1-inch diameter by 3-inch long dowels on each end of the wear strip. As a test on February 8 showed, this modification to the wear strip did not constrain the motion of the wear strip. Larger dowels (1.5-inch diameter by 4-inch long) were then installed in each end of another wear strip, and the test was repeated.

The larger dowels initially constrained the wear strip motion but subsequent tests revealed additional motion, suggesting that the baseplate material was yielding as in the previous test. On March 15, an attempt by LM to minimize wear strip motion by installing shims in the gaps between strips also failed. With the failure of these attempts to secure the wear strips and given the fact that additional wear strip hold-down bolts were breaking, LM recommended that motion of the telescope in azimuth should be suspended until a solution for the track problem could be found. NRAO-GB has approached consulting engineers for recommendations on how to solve this problem. In the meantime, other commissioning tasks and systems tests that do not require azimuth motions are being undertaken.

Elevation Bullgear

LM attempted to reinforce one segment of the elevation bullgear by installing Kirksite at two additional locations between the segment and the gear wheel. As in a previous test, the segment was subjected to its maximum design load of 212,000 pounds, and the resulting motion of the segment relative to the wheel was measured. The segment motion of 0.005 inches was comparable to what was measured prior to the reinforcement. A different method of reinforcing the gear may be necessary to permanently secure the segment to the wheel.

Servo System

The velocity and acceleration of the azimuth and elevation drives were reduced by a factor of two to reduce forces on the azimuth track and elevation bullgear. These modifications to the telescope servo system are temporary, and the original design velocities and accelerations will be restored when the problems with the azimuth track and bullgear are resolved. A number of servo tests have also been conducted to set and check azimuth and elevation limit switches, to check subreflector motion, and to test the servo subcontractor's software.

Azimuth Wheel Bearings

Nine new bearings that will be used to replace substandard azimuth wheel bearings on the telescope arrived at the GBT site on March 29. FEMCO, the subcontractor who will replace the bearings, will begin its work on April 30.

HVAC System

The inability of the GBT HVAC system to adequately cool the Receiver Room on warm days has been attributed to air in the coolant lines. The original air bleeder valve on the coolant lines was replaced with a larger one, and additional bleeder valves were installed at other locations in the system. A portable charge

pump was used to add additional coolant and force any remaining air out of the lines. The lines should now be completely charged with coolant, and the HVAC system should be able to adequately cool the Receiver Room.

Overstressed Structural Members

One of the more severe design cases on the GBT showed that two structural members in the telescope box structure can be overstressed. LM reinforced these members so that they could accommodate the design stress.

GBT Electronics Development

GBT Spectrometer Hardware

Modifications to the 1600 MHz phase-locked loops in the samplers have been designed and tested. These modifications reduce the levels of spurious components of the 1600 MHz signal by at least 30 dB, and tune the loop bandwidth to take better advantage of the phase stability of the VCXO. To enhance reliability, chip capacitors on the Long Term Accumulator boards are being replaced. To date, three of the ten have been completed. Two meetings regarding the addition of a pulsar spigot were held. Prior to the second meeting, Escoffier produced a fairly detailed design and McKinnon produced a strawman system requirements document.

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

Other than the installation of the holography reference horn on the GBT, there was no activity on the holography receiver this quarter.

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 second 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. Due to atmospheric limitations, the receiver cannot be productively used until the third quarter of 2001.

GBT Cryogenics

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

GBT Computing and Software Development

With the start of GBT commissioning on 5th February, the majority of the efforts of the GBT software group turned to commissioning support and bug fixing. The main items were assistance in the commissioning of the basic antenna modes, and enhancements and bug fixes to the glish observing procedures (GO). In addition, numerous more minor bugs were identified and fixed in other parts of the M&C system.

The control system has not yet achieved the degree of reliability and robustness that we would like. In addition, some major functionality (e.g. support for the Spectrometer) has yet to be completed, and the general level of "user-friendliness" needs to be improved. However, we believe that we are making strong progress, and the results to date demonstrate that the underlying system architecture is sound.

Commissioning Support

Considerable work was done on the antenna software, including a port of the Antenna Manager to Solaris (the original VME mv167 system was being pushed to its limits), installation of the planned security features to control access to the Manager, and provision of an improved simulator to allow software development to proceed when the real antenna was in use. The performance of the antenna in the basic observing modes (slewing, tracking, use of a pointing model and acceptance of local pointing offsets and so on) has been thoroughly tested. A bug was found in the "jerk minimization" algorithm for small steps, and this has been temporarily disabled.

As for the antenna, considerable work was done on the GO observing procedures to support the basic commissioning observations. This included implementation of refined procedures for performing different types of pointing observations, and in collaboration with the AIPS++ system a mechanism for triggering the AIPS++ pointing reduction software and automatically returning the resulting local pointing corrections back to GO. Planetary tracking using the JPL ephemerides was implemented for the first visitor observations (see below). Various other more minor enhancements and numerous bug fixes were made.

The highlights of the period were the observations of Venus and a near-earth asteroid for the Arecibo-GBT bi-static radar experiment. There were a number of problems during the setup for this (due mainly to hardware problems with some single-board computers). In addition, we had some problems with the antenna software during the observations. However, no data were lost due to any GBT system problems throughout the three days of observations, and so from the M&C point of view we considered the experiment a great success. Venus was tracked via the GO planetary procedures, which read a JPL ephemerid and send the appropriate demands to the antenna software. The asteroid was tracked by commanding successive J2000 positions at the appropriate times. Both of these were a stringent test of the current capabilities of the GBT control system and we are very pleased with its performance.

Instrumentation

Progress on the Spectrometer has been slow. As stated in the last report, we have been able to write FITS files for the most basic observing modes for some time. However, completing the implementation of multiple bins (e.g. for frequency switching) and use of multiple banks of the spectrometer has been harder than expected. In addition, we have been plagued by hardware problems with the VME SPARC CPU cards and a problem (thought to be a bug in a device driver) which causes the Spectrometer Manager to intermittently crash the operating system. We hope these problems will be resolved on time scales of weeks. At the same time, we continue to liaise with the AIPS++ group to agree the specific details of the FITS file interface, and the required operation of the AIPS++ filler.

Apart from the Spectrometer, commissioning observations have revealed numerous minor bugs in many of the individual device managers; we have been fixing these as rapidly as possible. By and large, the underlying infrastructure software has been very reliable.

Part of the hysteresis problem seen in early commissioning observations was traced to errors in the way the DCR Manager calculated the start time of each integration. Having cured this bug, a smaller hysteresis residual remains; this is most likely a problem in the way the DCR assigns individual dumps to successive integrations. Further investigations are currently on hold.

Metrology System

We have now demonstrated that the laser rangefinders can successfully hit targets on the feed arm over a range of elevations. This demonstrates that both the telescope encoder information and the FEA model are being used correctly.

Other

The GBT back-end computer and RAID array (a Sun Enterprise 450 server) has been installed and configured. Detailed discussions are underway concerning the disposition of the computing infrastructure funds; the two main items will be completion of the internal network upgrade and upgrades to the general site servers.

Mechanical Engineering Development

In February, the holography reference horn was completed and installed, and the spillover shield was tested. The spillover shield has been removed, modified and is ready for final installation in April. The tachometer covers for the Az and El motors have been completed and installed. Fabrication for the optical guide telescope was completed in March and is being RFI tested. Also, in March, fabrication was completed on a feed handling cart for the larger feed horns. The mechanical division has been supporting the effort to control Az track movement. The shop has assisted with tooling and has fabricated custom dowel pins for each drilled hole as part of concept testing.

The coming quarter will see the installation of the optical guide telescope and the final installation of the spillover shield in April, as well as continued support of the AZ track effort.

GBT Operations Summary

GBT Operations Documentation

Development of operational procedures continues into 2001. Drafts for Visitor safety briefing, Cleo gateway management, Radio communications, power outages, signal path setup, Operations and Maintenance Logs, "GO" and "CLEO" startup procedures, M&C start and restart, quick reference topics, GBT weather restrictions, reference information procedure for S-band receiver gain versus polarization optimization were completed and added to the Operations Manual during the first quarter.

Frontpage templates for use in Operations documents were refined and completed during the first quarter of 2001. The basic version of the Operational Manual has been converted using the new templates and will be available on the web during April. Hard copies of the manual are currently available.

GBT Maintenance

Regular preventative maintenance duties began during the first quarter. Some of these included: inspection and lubrication of subreflector actuators and limits, cleaning and lubrication of azimuth and elevation motor drive couplings, lubrication of feed arm manlift rack (including adding oil to gear box), inspection of stow pin actuator and relays, cleaning the azimuth track of grease (leaks from azimuth bearing seals), lubrication of a prime focus feed mount travel limit switch, lubrication of "B" and "C" hoists, cleaning of some azimuth brakes, inspection of some azimuth gear boxes for water contamination, and other miscellaneous PM inspections.

A daily structural inspection walk through was implemented during the first quarter of 2001. From these walkthroughs a list of operational concerns has been developed. The list will continually be updated and monitored for resolution to the problems discovered.

A plan for the quarterly testing azimuth wheel bearing grease was developed including cost estimates. The first test of azimuth wheel bearing grease will be completed next quarter.

The investigation of a contract for structural inspections will be started during the next quarter.

GBT Operator Training

Training on the upper elevator and in the operation of other mechanical equipment was completed during the first quarter of 2001.

The essential operator training for operations of the GBT was completed during the first quarter. As the systems change and settle down in their design and as more experience is gained in using the different systems, operator training will continue.

GB Maintenance Bookkeeping

The first major revision of the detailed plan for implementation of the Mainsaver software (for work order processing and PM planning) was completed during the first quarter of 2001. Extensive training for one member of the Operations division was completed. Much of the effort has been directed at coordinating the implementation of Mainsaver with the major revisions being implemented in Socorro.

All of the necessary software, and hardware required to run Mainsaver was installed during the first quarter of 2001. Initial setup options have been decided and some (minimal) data entry has begun. The goal is to have some Telescope Operations PM functions implemented by the end of the second quarter of 2001.

GBT Operations

Operations of the GBT on a regular basis for commissioning efforts began during the first quarter from the servo room on the telescope alidade. The plan is to move the operations center to the Jansky Lab during the second or third quarter of 2001.

The preliminary version of the GBT operator logging program specifications will be completed during the second quarter of 2001.

Many operating procedures were developed during the first quarter (some of these are listed un the GBT Documentation section above).

The software to handle the first stages of GBT proposal processing is being modified to handle the scheduling processes as well. This development will continue into the rest of 2001 and possibly later.

Mechanical Engineering and NRAO Central Instrument Shop

Milestone	Original Date	Revised Date	Date Completed
Fab. ALMA laser test source box	01-12-01		01-12-01
Fab. 10, 100 GHz MMIC bodies for Central Dev. Lab	02-28-01		01-23-01
Fab. dewars for Tucson / ALMA project	04-20-01		
Fab. five 385-520 MHz amplifier bodies	04-09-01		04-09-01
Fab. two WR-10 MMIC amplifier bodies	04-18-01		
Fab. ten 510-690 MHz balanced amplifiers	04-30-01		

Astronomy Education Center Project

Milestone	Original Date	Revised Date	Date Completed
Complete architectural detailed design	12-14-00	02-01-01	03-31-01
Design Review w/ NASA	01-04-01	04-12-01	
Bid Advertisement for main AEC building	01-25-01	04-23-01	

Electronics Engineering

OVLBI Tracking Station

This quarter we continued 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

Installation and termination of the optical fibers in the Jansky Lab are now largely complete. However, we have been requested to place the entire shielded rack containing the second floor network switches into the anechoic chamber for RFI testing. This has delayed the start date for transferring staff to 100 Mbit connections. Work has started in the residence hall, and the fiber installation is well under way.

The new AS/400 business computer has been installed in the shielded area of the Jansky addition, and this is now the production machine. The transfer from old to new machines went extremely smoothly; training for the new applications will start in April. Some of the NT servers have also been moved to this location, and the move of the Unix servers should be completed in April.

We purchased nine new desktop PCs at the end of the last fiscal year to upgrade the most heavily used machines (e.g. Autocad users) and allow the "trickle down" of the current machines to less demanding applications. The majority of these have now been installed. In the end, two machines were configured as dual-headed Linux workstations, and placed in the GBT servo room to serve as the temporary Operator/Observer workstations for operating from that location.

The Sun Enterprise 450 (GBT data handling system) was delivered, installed and configured. We are taking the opportunity caused by the delay in full GBT operations to thoroughly benchmark this machine. We have supported the installation of two visitor back-ends, each with their own data acquisition workstation.

We have started the detailed specification of computing purchases from the Green Bank infrastructure funds; the main items being completion of the internal network upgrade, and general site server.

Mechanical Engineering

In addition to the GBT work the Central Instrument Shop has also been supporting ALMA. In January the shop assisted in the development and completed fabrication of the nutator assembly and dummy mirror, fabricated a radiometer heat load assembly, and began work in January on an order for 10 power supply supports. These projects were completed this quarter and we are now fabricating some additional power supply parts. In February work was done on development and fabrication of an MMA feed horn, and in March work was done on the ALMA-B holography feed. During this quarter the shop also completed 10 MMIC amplifier bodies.

In the coming quarter, the Central Instrument Shop will continue working with Tucson on ALMA projects, which thus far includes dewars for the two test antennas. Additional amplifier work for the Charlottesville lab this quarter will include five 385-520 MHz amplifier bodies, two WR-10 MMIC amplifier bodies, and ten 510-690 MHz balanced amplifiers.

Operations - Other Telescopes

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

All of the USNO hardware that is to be shipped back to USNO has been identified and agreed upon. Most should be returned to USNO by the end of the second quarter.

The 20m will be mothballed after VLBI tests supporting the GBT have been completed, probably during the third quarter of 2001.

The two GBI telescopes will be mothballed during the second or third quarter of 2001.

The 45 Foot HALCA tracking station will continue operation into 2001. Although reduced funding for 2001 coupled with increased pressure of fewer tracking stations has reduced reliability of this operation during all of 2001, many successful observation sessions were completed during the first quarter of 2001.

A part time OVLBI operator was hired in the first quarter to replace the transfer of an operator out of the group.

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.

During the last quarter, the detailed architectural design of the center was completed. A review meeting with NRAO, NASA, and the architects will be held on April 12. Following a successful review, the project will be put out for construction bids.

Electronics

Milestone	Original Date	Revised Date	Date Completed
VLA/VLBA Pie Town Link (LO/IF)			
Complete construction & checkout of spares	01-31-01	11-30-01	
Decide on the next steps for the link, such as development of an improved round trip phase measurement and operation of the link using a single fiber	12-31-01		03-30-01
Reduce temperature sensitivity	01-31-01	11-30-01	
Propose and test scheme to measure round trip phase	06-30-01		
Reduce fiber use to single fiber	11-30-01		
Increase dynamic range	11-31-01		
Use spare VLA antennas in VLBI	06-30-02		
Receivers (FE)			
Build and install five more 7 mm receivers	01-31-01	01-30-03	
Install solar calibration on one 7 mm receiver	12-31-00	03-30-01	03-30-01
Complete solar calibration work	12-31-00	12-31-01	
Installation of six more K-band receivers (18-26.5 GHz) at VLA	01-31-01	02-28-02	
Build and install three more W-band receivers	10-31-01		
Replace Y-coupler on W-band receivers #2 to #4	08-30-01		
Build second "SOIDA" receiver test stand	12-31-01		
Test and begin replacement of new material for Dewar windows on L-band receivers (FE)	12-30-01		
Identify and correct moisture buildup problem in new VLA K-band feeds (FE)	12-30-01		

Milestone	Original Date	Revised Date	Date Completed
Test re-worked water vapor radiometers	12-31-01		
Atmospheric Phase Interferometer (FE)			
Complete construction of RF chassis for API (Atmospheric Phase Interferometer) (FE)	12-31-00		01-31-01
Upgrade for Pulsar High Time Resolution Processor (DCS, NM Tech)			
Release for construction, Fast Analog to Digital Converter (FADC) assembly	01-31-00	8-31-01	
Checkout of VME timing card & multi A/D FADC	01-31-01	05-31-01	
Checkout of full FADC	09-30-01		
Other VLA			
Demonstrate RFI from samplers & fiber optic transmitters can be reduced to acceptable levels (IPG)	12-31-01		
Monitor RFI environment at VLA 1 - 18 GHz (IPG)	12-31-01		
Construct VLA correlator controller (Correlator)			06-30-00
Continue development of 10 Gbps fiber optic link for ALMA project; work may transfer to EVLA project	12-31-01		
Develop block diagram for M&C, wyemon alarms, voice communication. (DCS, LO/IF, Comp. Div, ES Div)	12-31-01		
Improve alarm reporting by the "wyecom" alarm system (DCS)	12-31-01		02-28-01
Modify helium lines to facilitate testing new receivers (Cryo)	01-31-01	12-31-01	
Test higher volume helium compressor (Cryo)	12-31-01		
Test vacuum pump upgrade (Cryo)	12-31-01		

Milestone	Original Date	Revised Date	Date Completed
VLBA Improvements for W-band (Special Projects, ES Division)			
Use prototype system to measure and correct panel errors at VLBAPT using microwave holography	12-31-00	05-31-01	
Adjust VLBA main reflector panels to achieve best efficiency at W-band	01-31-01	12-31-02	
Develop a means of measuring & correcting VLBA subreflector surfaces	12-31-01		
VLA 74 MHz dipoles (FE)			
Key H & V polarizations	05-30-01		
Change FE filters to 3 MHz	12-31-01		
Iridium Filters (FE)			
Install & test prototype filters on VLA to reduce impact of spurious radiation in Radio Astronomy OH-band near 1612 MHz	01-31-01	08-30-01	
Install filters on all VLA antennas if tests prove successful	12-31-01		
Hydrogen Masers (LO/IF)			
VLBA Hydrogen Maser repair (#4) (LO/IF)	12-31-00	12-31-01	
VLBA Hydrogen Maser #11, replace (LO/IF)	12-31-00	06-30-01	

Engineering Services

Milestones	Original Date	Revised Date	Date Completed
Overhaul Antenna 5	01-15-01	01-24-01	02-22-01
Replace Los Alamos Elevation Bearing	01-12-01		01-12-01
Complete B-Array reconfiguration	02-23-01		02-22-01
Complete CnB-Array reconfiguration	06-08-01		

Milestones	Original Date	Revised Date	Date Completed
Complete C-Array reconfiguration	06-29-01		
Mechanical Group			
Assemble three spare Dichroic panels for VLBA	05-31-01		
Install Q-band receiver on VLA Antenna 23	01-30-01	03-30-01	03-01-01
Begin installation of VLA Fall Arrest	01-22-01		01-22-01
Test transporter limp pump system and modify transporter to limp over the roughest sections of the track	03-01-01		01-23-01
Assemble one spare VLBA wheel assembly	03-30-01	05-15-01	
Complete VLBA handrail fabrication	04-27-01		
Complete Antenna 9 overhaul	04/12/01		
Complete Antenna 3 overhaul	05-29-01		
Complete painting Antenna 27	05/25/01		
Install W-band mount on Hancock VLBA Antenna	05-11-01		
Complete antenna dish panel adjustments on Antennas 2, 18, and 21	05/28/01		
Replace azimuth bearing on Antenna 17	08-31-01		
Electrical Group			
Install HVAC and plumbing systems in preparation for ALMA office space	03-30-01		03-12-01
Radio upgrade	12-28-01		
Upgrade fire alarms	11-30-01		
Site & Wye Group			
Clean and 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		01-31-01

Milestones	Original Date	Revised Date	Date Completed
Build and replace deteriorated antenna station fence corner braces	01-31-01		02-16-01
Complete waveguide Lightning Protection System repairs	03-30-01		03-22-01
VLBA Shop roof repairs	03-30-01		03-08-01
Complete earthwork for ALMA Test Site (Preliminary)	01-31-01		01-31-01
Redo exterior stucco on Guest House	06-29-01		
Pour concrete for ALMA antenna foundations	06-29-01		
ES Engineering Group			
Build optical telescope for measuring antenna-pointing efficiency and pinpointing causes of pointing errors	01-31-01		1-31-01
Replace structural modeling and analysis of Los Alamos El Bearing	1-04-01		01-04-01
Prepare work for fabrication of ALMA Bins and Modules	01-31-01		01-31-01
VLA visitor center roof repair	02-10-01		02-28-01
Machine four W-band Long Cal couplers	12-20-00	02-25-01	01-15-01
Machine five K-band F14 Modules	01-18-01		01-15-01
Machine K-band Phase Shifter Mandrels	01-29-01		03-05-01
Communication between HP calculator and STV Optical telescope for data logging	01-31-01		01-31-01
Machine seven K-Q feed cones for Antennas 18-24	02-01-01	09-18-01	
Machine three W-band front ends for Antennas 7-9	02-13-01		03-05-01
Machine FE power supply cases	02-15-01		01-30-01

Milestones	Original Date	Revised Date	Date Completed
Complete ALMA antenna foundation construction	08-06-01		
Administrative (Scheduling-Safety)			
Arrange removal of used oil and grease by EPA-authorized collector	12-08-00	01-17-01	01-17-01
Begin the trial 4-10 schedule	01-02-01		01-02-01
Removal of sludge from used oil tanks	03-30-01	06-30-01	
Hazardous material inventory (HAZMAT) update	10-31-01	01-31-01	02-28-01
HAZMAT/MSDS Refresher session	04/26/01		

The completion of the spare VLBA wheel assembly was not completed due to vender delay on delivery of needed bolts. The machining of seven K-Q feed cones was rescheduled until September because they are not needed until that time. Arrangement for the removal of sludge from used oil tanks is delayed because the bids received were too high. The bidding process will be reinitiated. The HVAC component changes at Kitt Peak will take place on the scheduled visit April 3.

Computer Division
Systems Support Group

Milestone	Original Date	Revised Date	Date Completed
CUPS installation	12-31-00	03-31-01	03-31-01
Arana Removal	09-30-00	09-30-01	
Video conferencing	01-31-01	Pending	
Solaris 2.8 installation	07-31-01	07-31-01	
RedHat 7.1 installation	07-31-01	07-31-01	
System file clean-up	12-31-00	03-31-01	03-31-01
Web/ftp server	08-31-01	08-31-01	
New PC order/installation	05-15-01	05-15-01	
Replacement public machines	09-30-01	09-30-01	
Off-load zia server	09-30-01	09-30-01	
Expand filehost file-server	06-30-01	06-30-01	
Jobserve	02-28-01	04-30-01	
VLA Web pages	06-30-01	06-30-01	

CUPS Installation

The new Unix printing system CUPS was installed at the AOC, and documentation was made available. This new printing system takes full advantage of our existing printers and allows most standard file formats to be sent directly to the printer.

Arana Removal

Removal of the arana file server is now waiting for the conclusion of the VLA scheduling software rewrite based on Sybase. The old system still uses DBase IV, an obsolete product which is tied to arana.

Video Conferencing

The order and installation of additional Video conferencing equipment did not take place because no funding for this was made available. We will hold off on this until funding materializes.

Solaris 2.8 Installation

At the AOC, we have installed a handful of test Solaris 2.8 systems. We have gained sufficient expertise with this new system that we are ready to migrate most Sparc systems to Solaris 2.8. We expect this to take place in the course of April 2001. We hope to complete the entire upgrade except for selected servers by the middle of June. The remaining unique systems should be upgraded by late July.

RedHat 7.1 Installation

We also gained experience with RedHat 7.1, which comes with the new Linux kernel (2.4.x) supporting files larger than 2GB in size. The AIPS and AIPS++ groups are currently working on large file support for Linux machines. A large-scale upgrade to 7.1 is planned for the coming months (April and May 2001). If the AIPS/AIPS++ large file support is completed before the upgrade to Redhat 7.1 begins we will upgrade some or all of the existing Redhat 6.2 machines to the 2.4.x kernel. system file clean-up.

The local system files have been thoroughly combed through. All host and file-system information files have been cleaned. The user-based files have been scanned and all stale entries have been deleted. All user accounts are now referred to as /users/username which greatly simplifies maintenance and conforms with recently agreed upon NRAO-wide usage.

Web/ftp server

The planned installation of a local dedicated Web/ftp server was postponed since no funding had been made available. The actual installation will be done by NRAO-CV; a local migration plan is being worked on by Stephan Witz.

New PC order/installation

We ordered eight new high-end PCs to replace current PCs on the desks of the heaviest AIPS users. These machines are estimated to be three times as fast as their current machines, and will have twice as much disk. Other machines made available by this purchase will be used to accommodate the 14 summer students which will arrive starting mid May.

Replacement Public Machines

We agreed to replace the majority of our public machines by high-end dual-processor Linux PCs. For a variety of reasons (availability of dual Pentium 4, availability of large file support) we don't expect this order to go out before the end of the summer.

Off-load Zia Server

Currently zia (an aging Sparc-20) handles all of our Web, Mail, DNS IMAP, SAMBA and POP services as well as password verification and software licenses. Over the next several months we will begin migrating most of these services off of zia onto dedicated systems. We would like to remind everyone that they should use the alias 'mailhost' when referring to zia for mail services such as IMAP and POP. Using mailhost' now will greatly reduce the impact when we migrate the services.

Expand Filehost File-server

Filehost will be getting a new disk array which will effectively double the available disk storage. The increased storage will go primarily toward increased space for personal accounts, storage areas for the VLBA and development areas for the EVLA and ALMA projects.

Jobserve

Release version 1.6.2 of Jobserve. This version will mainly contain bug fixes.

VLA Web pages

The current structure of our VLA Web pages has gradually become obsolete; a project has been started to restructure these pages which will allow for easier growth and further development.

Array Support Group

Milestone	Original Date	Revised Date	Date Completed
Deploy OMS in VLBA correlator	02-15-01	02-28-01	02-26-01
Automate VLA pointing processing	03-01-01		02-21-01
Long-term VLA pointing analysis	03-01-01		02-21-01
Test SLC/DCS on VLA	03-01-01	03-15-01	03-15-01
Preliminary test of new VLA correlator controller	03-15-01		03-15-01
Full test of CMP on the VLA	04-30-01		
Dynamic scheduling enhancements in OMS	05-30-01		
Turn over ancillary data procedures to VLA operations	06-30-01		

A major milestone was reached with the deployment of the new (OMS) control software for the VLBA correlator. This has proved, as planned, to be more reliable and more expandable than the old system (CJOBS). Several features which make the VLBA correlator easier to use by the operations group have been added since the change over. These include easier modification of the antenna configuration, vastly improved tape performance statistics, and improved diagnostic displays. Dynamic scheduling enhancements are planned for the next quarter.

A new driver is needed to support the new Sigma Tau masers on the VLBA. This has been written and installed and is running on the test fixture. Final checkout will be done when the equipment is delivered.

We plan to continue to automate some of the features of the present VLA on-line system to free software engineering effort for the EVLA design. The VLA antenna pointing procedures were completed and will be taken over completely by the VLA operations group in the next quarter.

Procedures are also being developed for tipping data and VLA calibration data needed for VLBI observations. These should also be available for use by VLA operations next quarter.

Significant effort was spent in support of the combined operation of the VLBA Pie Town antenna with the VLA. We have developed a proposed list of changes, tests, and investigations that need to be completed before the next VLA is next in the "A" configuration. In particular, we may want to move the phase center

of the VLA to the west when observing in conjunction with Pie Town. To make the VLA usable with 70 MHz bandwidth, a new set of delays had to be determined. Support for 70 MHz bandwidth test experiments is ongoing.

The analysis of the VLA antenna long-term pointing trends are complete. We have made some suggestions to help to determine antenna tilt after antenna moves.

Several members of the group contributed significantly to the preparation of the Addendum to the EVLA Proposal to the NSF. Although funding for the project is not yet available, some effort is being put into considerations for an eventual design of the computer systems, in particular for the control computers and their interface to the proposed WIDAR correlator. A working document has been made publicly available to solicit comments from the group and other interested parties. Investigations into applicable technologies also are proceeding.

We have made tests of the new interfaces to the present VLA hardware that will be used in the EVLA. Preliminary tests of the new correlator controller exposed a hardware problem that will have to be addressed before full deployment.

A major milestone was also reached when the interim Control and Monitor Processor (CMP) was deployed on the VLA in monitor mode. This is the device that will interface to the Serial Line Controller (SLC) of the Digital Control System (DCS) with the computers of the EVLA. Tests of the device to send commands while monitoring are planned for the next quarter.

AIPS

Versions

In December 2000 and January 2001, a version of AIPS, christened 31DEC00, was frozen and released. This release, available on CD or via ftp, was necessitated by the implementation of a number of new features, and the reluctance of users to sign up for the regular Midnight Job. The current test version is 31DEC01. Although a frozen release takes considerable effort, the plan is to make one release per year in order to prevent the versions at many external sites from getting too out-of-date.

The 31DEC99 version, "AIPS for the Ages," was distributed 407 times via ftp. Through the first quarter of 2001, there were 116 distributions of 31DEC00 (90% ftp) and 158 ftp's of 31DEC01. About 60 percent of the registrations for the newest versions are on Linux architectures.

Personnel

Chris Flatters left the AIPS group in late 2000, and Eric Greisen moved "permanently" to Socorro, where Jim Ulvestad now heads the AIPS group. In January 2001, Amy Mioduszewski joined the AIPS group, with a focus on providing VLBI support and extending the procedures for VLBA data reduction in AIPS.

Key Developments

- Large-file support (greater than 2 Gigabytes) has been tested, as supported under version 2.4.2 of the Linux Kernel. Tests using wide-field VLA mapping at 74 MHz have been successful.
- New procedures have been developed to carry VLBI data calibration all the way through fringe-fitting, the last step prior to imaging and self-calibration. Procedures that take the users through the initial amplitude calibration are available in 31DEC00, while the additional delay-calibration steps (pulse calibration and fringe-fitting) require a recent version of 31DEC01. The first release of AIPS Memo No. 105, "AIPS Procedures for Initial VLBA Data Reduction," covers the procedures available in 31DEC00. These procedures are accessed via the runfile VLBAUTIL.
- The CROSSPOL procedure, which calibrates polarization leakage terms for VLBI observations, was modified to increase the robustness by removing hidden variables.
- The task CONFI, used for simulations of possible ALMA configurations, has been expanded to handle as many as 2000 antennas, enabling use in configuration studies for the Square Kilometer Array.
- FITLD was modified to recognize correlators other than the VLBA correlator, and turn off all VLBA-related options that are incorrect for the other correlators.
- BPASS was modified to correctly shift spectra from the center of the Earth to the locations of the antennas on the surface of the Earth.
- Algorithms for plotting fields including the North and South Poles were fixed to provide more accurate right ascensions and meaningful tick marks.
- Modified tasks SETFC and FACES to provide more flexibility in multi-field imaging.
- Small errors corrected in a number of tasks.

Goals for Q2 2001

1. Continuing maintenance and user support.
2. Install large-file support on all Linux machines in Socorro.
3. Revise documentation for VLBA data-reduction scripts.
4. Complete error tests for Gaussian fitting routines.
5. Low-level code development in support of NRAO instruments.

Major Developments

Milestone	Original Date	Revised Date	Date Completed
Refine 4-12 GHz amplifier	02-16-01		02-16-01
Design L-band amp using InP devices	03-16-01	04-30-02	
Improve noise test systems	03-16-01		03-16-01
Complete 84-116 GHz SIS mixer design	02-16-01	04-30-01	
Demonstrate 211-275 GHz balanced sideband-separating mixer with L-band IF			02-15-01
Initial tests of 600-720 GHz SIS mixer	03-16-01	06-31-01	04-04-01
Study use of overmoded SS w/g in LO/mixer fabrication for ALMA receivers	03-16-01	06-16-01	
Measurements of absorbing materials as IR-blocking filters	03-16-01		03-30-01
Demonstrate 211-275 GHz balanced SIS mixer with integrated 4-12 GHz IF preamp	06-29-01		
Demonstrate 211-275 GHz balanced sideband-separating SIS mixer with integrated 4-12 GHz IF preamps	07-31-01		
Far-field pattern measurements of K-band feeds			02-01-01
Analysis of waveguide feed between 100-108 GHZ			03-14-01
Far-field pattern measurements of scale model feed at C-band			03-22-01
Analysis of band 6 optics	04-30-01		
Deliver antenna test correlator	12-27-00	01-31-01	2-21-01
ALMA Correlator: 1) Perform final testing of both the ALMA correlator filter and station cards using the card test fixture, 2) Publish a test report on the filter card performance, 3) Complete testing of the LTA prototype card, 4) Complete layout of the correlator 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	06-30-01		

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, 7) Completion of the design and PCB layout of a correlator chip test card	03-31-01	06-30-01 06-30-01	03-31-01 03-31-01 03-31-01 03-31-01 03-31-01
Initial test of prototype ALMA correlator.	12-21-02		
Complete 80/240 GHz tripler design	12-27-00	01-12-01	01-30-01
Development of 80-240 GHz tripler mask set	12-27-00	01-12-01	02-15-01
Construct 80/240 GHz frequency tripler	03-30-01	05-15-01	
Contract for development & fabrication of monolithic frequency multipliers	01-31-01		03-30-01
Design MMIC doubler chips for ALMA Band 7	06-01-01		

Amplifier Design and Development

Work continued on refining the design of the 3-13 GHz amplifier, primarily in the context of its use as part of the SIS mixer-preamp combination. Some design work was performed on balanced amplifiers in the 1-2 GHz range.

The amplifier group has continued to support the ALMA project with manpower 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. Recently this has focused on adding new K-band noise measurement capability to free up existing test system time for low frequency and ALMA-related measurements.

Amplifier Production

A total of 16 InP amplifiers was completed during the quarter. Production included: six K-band, four W-band, and six 8-18 GHz amplifiers. Additionally, a build of 19 3-13 GHz amplifiers is nearing completion, with six at the 90 percent completion point and the remaining 13 better than 50 percent complete.

A total of five balanced amplifiers was delivered this quarter.

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 (84-116 GHz) is still open. To obtain a comparison between the two types of receivers, we are developing a tunerless SIS mixer for this band capable of operation with a 4-12 GHz IF. A fixed-tuned waveguide probe has been designed using the EM simulator *QuickWave*. Other parts of the mixer circuit are currently being designed and optimized using Sonnet and MMICAD. A mixer design and mask layout will be completed by the end of April.

211-275 GHz balanced sideband-separating mixer —- A. Single-Chip design: This design has three RF quadrature hybrids, an in-phase power divider, four SIS mixers, and their RF tuning circuits on a single 2 x1 mm quartz chip. The wafers are fabricated at UVA. First tests of these mixers, using an L-band IF, have given a single-sideband receiver noise temperature of 120-200 K over ALMA Band 6 (211-275 GHz) — which is 11-18 hν/k. The design of a modified mixer block suitable for the 4-12 GHz IF preamp is almost complete.

211-275 GHz balanced sideband-separating mixer — B. Multi-Chip design: This design uses four separate SIS mixers of established design, mounted in a block containing three waveguide quadrature hybrids and an in-phase power divider. Work is under way on layout of the mixer block to be compatible with the 4-12 GHz IF amplifiers, and the design of the waveguide components within the block. The design of the waveguide quadrature hybrids is described in ALMA Memo #343.

211-275 GHz single-chip balanced mixer with 4-12 GHz IF: This design uses the successful single-chip balanced mixers fabricated at UVA, and is integrated with the 4-12 GHz IF preamp. It is an ALMA fallback design in case the balanced sideband separating mixers have insufficient yield or other problems. The mixer block is now being made.

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. The first 600-720 GHz mixer was successfully assembled and DC tested on 1/12/01. The RF evaluation of the mixer was hampered by the failure of the two solid-state LO sources, but experiments using the UVA FIR laser source showed that the mixer had reasonablely LO response at 585 and 690 GHz. The two damaged LO sources have been repaired by the vendor and were returned at the end of March. RF evaluation of the mixer has begun with a successful pumping test on 4/4/01.

During this quarter we have assembled 28 SIS mixers, all from UVA: 24 balanced sideband-separating mixers for 211-275 GHz, three single-ended mixers for 602-720 GHz, and one single-ended mixer for 211-275 GHz. Many of the balanced sideband-separating mixers were lost to static discharge because of a bench grounding wire that came adrift. This problem has been remedied.

4-12 GHz IF Preamplifier Development

The 4-12 GHz IF preamp reported last quarter has been modified for the latest batch of InP transistors. With a 50-ohm source, the amplifier noise temperature is 3-6 K. With a single-ended SIS mixer, an overall receiver noise temperature of 40-60 K DSB was obtained over ALMA Band 6 (211-275 GHz). The gain of the preamp using these devices rolls off at too low a frequency (10.5 GHz instead of 12 GHz). This is believed to be due to an inaccurate equivalent circuit model for these devices, and we are now trying to develop a better one.

We have completed the design of a 4-12 GHz preamp with dual SIS bias circuits—required for biasing a balanced SIS mixer—and a split microstrip input circuit with DC isolation. This is in the shop and should be finished in the next quarter.

Mixer-Preamp Interface Design and Production Test Set (ALMA Band 6)

The baseline design for ALMA Band 6 uses balanced sideband-separating mixer-preamplifiers. Each mixer-preamp module requires up to 48 wires for mixer, amplifier, and magnetic bias, and temperature monitor, so connector miniaturization is essential and high reliability is crucial. We propose using Nanonics Dualobe connectors and have investigated the reliability of these. About 400 Nanonics connectors, some operating at 1.4K, are installed on the SIRTF spacecraft, which is currently undergoing ground testing at Ball Aerospace. We have had extensive discussions with Ball on their use of these connectors and have visited their facility to see how the connectors are used. A discussion of ALMA mixer/preamp interface considerations is given in ALMA Memo #344, "Mixer-Preamp to Receiver Interface Considerations for ALMA Band 6," and our findings on Nanonics connectors are described in ALMA Memo #356, "Reliability of Nanonics Dualobe Connectors."

Heatsinks for all conductors between 4 K and warmer stages must be efficient and highly reliable. We are evaluating a design which uses a PC board as heatsink with two 37-pin Nanonics connectors.

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.

We are exploring the use of an I2C digital interface to control the mixer bias supplies. This interface has the advantage that clock pulses are present only while commanding bias changes, so digital noise will be present only during mixer bias changes. This interface is also used by IRAM for their mixer bias supplies.

Automatic SIS Mixer Testing

Unless the sideband ratio of a heterodyne receiver is close to the ideal value, a correction is required to the single-sideband receiver noise temperature deduced from the Y-factor measured using broadband hot and cold loads. In principle, the sideband ratio of a receiver can be measured by injecting CW signals of known relative amplitudes into the upper and lower sidebands and measuring the IF response to each. At millimeter wavelengths, however, it is difficult to determine with sufficient accuracy the relative amplitudes of two low-level RF signals separated in frequency by twice the IF ($2f_{IF}$ = 8–24 GHz in the case of ALMA receivers). We have developed a method for determining the image rejection of a sideband-separating mixer using CW test signals in the upper and lower sidebands, even when the relative power levels of the test signals are not known. If, in addition, there is significant conversion gain from one or more of the higher harmonic sidebands, $nf_{LO} \pm f_{IF}$ (n = 2, 3,...), that must also be taken into account when evaluating the sideband ratio and the single-sideband receiver noise temperature. This is described in ALMA Memo #357.

We have completed installation of hardware to allow rapid measurement of the image rejection of a Band-6 mixer. This includes a solid-state millimeter-wave source operating from 200 GHz to 275 GHz and the requisite software to control its frequency.

Construction of the following components for the second mixer measurement system was completed this quarter: refrigerator remote control switch chassis, oscilloscope switching monitor chassis, and installation of the IF plate in the Dewar.

We have documented the mixer measurement procedures and written an operation and maintenance manual for the mixer-preamp bias supplies.

Vacuum Windows and IR Filters

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 (see ALMA Memo #340). Windows for Band 3 are now being fabricated.

Infrared filters are required for the ALMA production test receivers. A candidate for the filter material is HDPE, which has substantial absorption or scattering in the infrared and low loss in the millimeter bands. To investigate the practicality of matching grooves in HDPE, we have measured un-grooved plates and plates with linear and concentric rectangular grooves, and linear triangular grooves. At 75-110 GHz, measurements were made with an HP8510 and between 60 and 450 GHz with a low resolution FTS. This work is described in ALMA Memo #347.

Publications

S. Srikanth and A. R. Kerr, "Waveguide Quadrature Hybrids for ALMA Receivers," ALMA Memo #343, 11 January 2001.

A. R. Kerr, "Mixer-Preamp to Receiver Interface Considerations for ALMA Band 6," ALMA Memo #344, 18 January 2001.

G. A. Ediss and T. Globus, "60 to 450 GHz Transmission and Reflection Measurements of Grooved and Un-grooved HDPE Plates," ALMA Memo #347, 2 February 2001.

J. E. Effland, "Reliability of Nanonics Dualobe Connectors," ALMA Memo #356, 22 March 2001.

A. R. Kerr, S.-K. Pan and J. E. Effland, "Sideband Calibration of Millimeter-Wave Receivers," ALMA Memo #357, 27 March 2001.

E. F. Lauria, A. R. Kerr, M. W. Pospieszalski, S.-K. Pan, J. E. Effland and A. W. Lichtenberger, "A 200-300 GHz SIS Mixer-Preamplifier with 8 GHz IF Bandwidth," accepted for the IEEE 2001 International Microwave Symposium.

Electromagnetic Support

GBT

Far-field pattern measurements were completed on the K-band (18.0-22.5 GHz/22.0-26.5 GHz) feeds.

For the lower band feed, the pattern level at the edge of the subreflector varies between -13.0 dB and -14.5 dB in the frequency range 18.0 to 22.5 GHz with cross-polarization below -28 dB. The phase center is 6.95" behind the aperture plane and remains fixed in the operating band.

For the 22-26.5 GHz feed, the pattern level at the subreflector edge was measured to vary from -13.3 dB to -14.7 dB. Cross-polarization level is lower than -27.0 dB and the phase center is -5.75" behind the aperture.

ALMA

A waveguide feed with choke rings was analyzed between 100 and 108 GHz with Finite-Difference Time Domain software. This feed will be used for holography measurements of the ALMA prototype antenna. The far-field patterns of a scale model of the feed built at C-band were measured. There is good agreement between theory and measurements.

Analysis of the Band 6 (210-275 GHz) optics was begun.

Spectrometers/Correlators

Testing of hardware for the ALMA correlator continued during the last quarter. Three multi-layer logic cards, the long-term accumulator (LTA), the station card, and a test fixture card were assembled and prototype card testing started. In addition, the filter card/station card test fixture itself was completed and its testing begun.

The LTA card prototype testing occupied much of the quarter and has proceeded with few problems so far. The LTA card is being used as a development bed for system firmware centered around an Infineon C167 CPU.

Initial testing of the prototype station card was performed using a modified GBT test fixture while the ALMA test fixture was being completed. All internal functions of the card were successfully demonstrated during this initial card test phase.

The ALMA test correlator was delivered to and successfully demonstrated in Socorro. Both hardware and software performed satisfactorily during this demonstration.

The 4096-lag ALMA correlator chip design was completed by a vendor, and computer simulation of the design performed. Analysis of the computer simulation indicates both proper functionality and sufficient performance margin for the ALMA application.

NRAO did an independent computer simulation of the ALMA correlator chip. This simulation was directed at proving that the chip design performed the same as a C language correlator design and, hence, that the design was functionally as expected.

The design of the ALMA correlator card was completed during the quarter, and layout of the printed circuit card begun. The design of this card was awaiting the final package selection for the correlator chip and final pinout assignment.

The design of a logic card to be used for testing the ALMA correlator chip was completed during the quarter. A layout of the PCB for this card was also completed.

After some assistance from NRAO, a spectrometer designed by the Five College Radio Astronomy Observatory, using logic cards designed and built by NRAO for the GBT spectrometer, was able to pass laboratory testing.

During the quarter, a small amount of assistance was rendered to Green Bank in support of the GBT spectrometer. A logic card to stream data from the GBT spectrometer onto a tape-recorded system for pulsar observations was also begun.

A system to stream VLBA data from a VLBA playback unit onto a high-density computer RAID disc was also begun by the correlator group.

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.

A significant milestone in the LO source development was achieved this quarter when the YIG-based driver chain was phase-locked, for the first time, to the photonic reference system proving that this configuration could be made to work after some engineering refinements. Work continues on MMIC amplifier evaluation and component phase drift measurements.

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 are being developed. We have an ongoing contract with the Semiconductor Device Laboratory at the University of Virginia (UVA) to support semiconductor device research.

The 80/240 GHz frequency tripler was under construction this quarter. Significant progress was made on the fabrication of the quartz-backed GaAs diode pair after experiencing a six-week setback in the delivery of the semiconductor wafer material from a commercial vendor. As a substitute, a test wafer was processed to evaluate the procedure. The actual GaAs devices are currently being fabricated. The metal housing has been machined and the quartz circuits are currently being fabricated.

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. The Michigan group processed a discrete diode array with delivery expected in April. A design for the MMIC doubler chips for ALMA Band 7 is in process.

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, the antenna impedance measurements were conducted. The results suggest that the outer edge of the sinuous antenna is causing significant impedance variation over the 1.4-1.7 GHz band. Tests are under way to better understand the direct cause of the edge effect, and various ways to improve

the performance are being explored. This task is being conducted in collaboration with a Ph.D. student at the new Advanced Instrumentation Research Laboratory located in the Astronomy Department at the University of Virginia.

Meetings

Members of the CDL attended the following meetings this quarter:

IMS 2001 TPC Meeting, Phoenix, AZ, Jan. 6, 2001 (Pospieszalski).
National Radio Science Meeting, Boulder, CO, Jan. 8-11, 2001 (Pospieszalski, Webber).
12th Int. Symp. on Space THz Tech., San Diego, CA, Feb. 14-16, 2001 (Ediss, Effland, Koller, Pan)
MMA Oversight Committee Meeting, Washington, DC, February 15-16, 2001 (Webber).
Visit to Ball Aerospace, Boulder, CO, Feb. 16-17, 2001 (Effland).
ALMA Receiver PDR Meeting, Tucson, AZ, Feb. 19-20, 2001 (Ediss, Effland, Kerr, Lauria, Webber).
PDR Meeting for Bands 5 and 6 Mixers, JPL, March 29, 2001 (Pan).
HIFI LO PDR Meeting, JPL, March 30, 2001 (Bradley).

Data Management Initiative

Milestones	Original Date	Revised Date	Date Completed
GBT proposal prototype deployed	10-02-00		10-02-00
COBRA proposal submitted	04-09-01		04-09-01
NVO proposal submitted	04-23-01		
DM architect hired	06-01-01		
Archive proposal from STSCI due	04-29-01		
DM WBS out to 2006	02-01-01	06-01-01	

Work in the Data Management Initiative has continued to concentrate on acquiring resources. Although a well-formulated plan was presented in the NRAO Program Plan, the budget prevented implementation of most of this plan. We do have a position for a key role in DM: that of the principal architect. We are currently advertising this position internally, and hope to fill it soon. We have identified internal resources that can be used in conjunction with the architect to start making progress on short-term and medium term goals even in the absence of significant new funding.

The other prospects for some funding for the DMI are the COBRA and NVO proposals to the NSF ITR program, the EVLA project, and the ALMA project.

1. The COBRA pre-proposal was accepted and we were invited to submit a full proposal, which we did on April 9. The proposal is collaboration with NCSA and NAIC/Cornell. The goal is to provide archive and pipeline software and systems for use by the radio astronomy community. The proposal has a significant computing science development component, focused on meta-data and scientific portals, but is most strongly targeted toward using state-of-the-art computing concepts, such as the Grid, to provide computing facilities to a geographically and organizationally diverse group.
2. The NVO proposal is due for submission on April 23. NRAO is one of the collaborators in this proposal, which is being led by Paul Messina of Caltech and Alex Szalay of John Hopkins University. If funded, NRAO will receive some funding for two activities: definition of data models for NVO, and connection of NRAO/COBRA archives to the NVO.
3. Action in the EVLA waits funding and establishment of the EVLA project. More detailed calculation of the computing loads for the EVLA has been completed and incorporated into the planning. This work verifies that the computing for the EVLA is feasible if current growth rates of computing/dollar continue until deployment.
4. For ALMA, negotiations inside the ALMA project with regard to Phase 2 responsibilities continue. The NRAO position is that we would like to take responsibility for those areas of ALPMA software development that overlap most with the DM initiative: pipelines and post-processing software. An acceptance test for AIPS++ in ALMA is being discussed (see below)

Planning on acquiring and deploying archives for NRAO telescopes is a high priority. To avoid reinventing the necessary software, we are exploring the possibility of subcontracting the archive software to the Space Telescope Science Institute.

Technology Development

Milestones	Original Date	Revised Date	Date Completed
Start of GBT commissioning	11-29-00	01-19-01	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	09-01-01	
AIPS++ booth at AAS	01-07-01		01-07-01
AIPS++ User Group meeting	01-29-01		01-29-01
Parallel wide-field imaging	03-01-01		01-31-01
AIPS++ Developer's meeting	04-23-01		
AIPS++ Release v1.5	04-30-01	05-15-01	
WBS for AIPS++ Release 1.6	05-15-01		
DM Tech working groups established	05-20-01		
AIPS++ booth at AAS Pasadena	06-03-01		
ALMA AIPS++ test	08-15-01		
Prototype VLA pipeline	09-01-01		
AIPS++ Release 1.6	10-01-01		

Technology development in DM is based mainly on AIPS++. Other initiatives are appropriate in the future, but efforts this quarter in DM Technology have been focused on AIPS and AIPS++. In AIPS++, the guiding priorities have been increasing the scientific completeness of the package, expanding the user community through outreach and user support, and supporting GBT commissioning. These priorities were established in planning for the fourth public release (v1.5), scheduled for May, 2001. The first quarter of 2001 covered the second half of the six-month AIPS++ development cycle for v1.5. Increased scientific completeness has been achieved in several areas in the package, including image analysis, imaging and calibration, and visualization, amongst others. A particular focus at NRAO has been the expansion of the scientific completeness of VLA reduction capabilities. Preliminary VLBI capabilities were added during this quarter, in keeping with scheduled planning, although these capabilities will only be publicly available in the next quarter once adequately tested within the project.

User outreach and support have been pursued through engagement with scientific test groups at the AOC and Charlottesville, with whom we have had regularly scheduled meetings. These groups are working both on assigned standard datasets, and on datasets of their own choosing. They have been encouraged to

submit defects if they encounter errors during data processing. We have assigned 30% of developer time to fixing defects this cycle, up from 20% for the previous cycle. A significant effort has been devoted to direct user support during this quarter, including interactive tutorials. The AIPS++ User Group (AUG), which consists of external AIPS++ users, met in late January in Champaign-Urbana, and produced a review report for 2000/2001, which is available at http://aips2.nrao.edu/daily/docs/notes/241/241.html.

Efforts in support of GBT commissioning have included work on data formats, imaging and calibration. The single-dish imaging capabilities, which already existed in the package, were demonstrated and refined based on the early imaging data obtained during commissioning. GBT images have been produced from these data. Weekly meetings between GBT commissioning scientists and engineers and the AIPS++ project were established in this quarter, and have proved to be a valuable coordination mechanism.

In advanced development, Kumar Golap has demonstrated parallelized wide-field imaging for a 74 MHz VLA dataset taken towards the Coma cluster (Perley et al.). A 225-facet image of this region was achieved in a little over 10 hours using a 32-processor supercomputer at NCSA. This represents a significant speed-up and allows new science. This work is separately funded by the NCSA Alliance. Use of this method for other scientific datasets is underway at present, and will extend into the next quarter. Also, the continuing collaboration with the Pixons LLC to add the option of using a proprietary Pixon deconvolution library to AIPS++ has advanced significantly in this quarter. We have demonstrated the use of this capability with single-dish GBT imaging data. This work is being extended to interferometric deconvolution.

Discussions are proceeding with the ALMA project on a demonstration project for AIPS++. The purpose would be to determine suitability of AIPS++ for ALMA processing. AIPS++ has been designed from the beginning to excel at the type of processing required by ALMA, but nevertheless a demonstration would help show that package is indeed capable of processing ALMA data. Details are still being discussed but the demonstration will probably be an application of AIPS++ to IRAM interferometric data, showing that end-to-end processing is possible for millimeter wavelength observations.

During this quarter, Mark Holdaway transferred to the ALMA project, and was replaced by Kumar Golap, who moved from the NCSA parallelization grant.

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. More details on recent AIPS activities are given in the report for VLA/VLBA.

Central Computing Services

Tasks and milestones related to all of the projects described below have now been defined, including target dates and responsible staff members, and are being tracked centrally by members of the core Data Management group. The managers of the staff members involved meet biweekly and are responsible for assigning priorities and reconciling Observatory-wide priorities with local site support requirements.

Observatory-Wide Computing

Milestones	Original Date	Revised Date	Date Completed
Tucson compliant with security	12-31-00	03-31-01	03-31-01
Revise security policy	02-15-01	04-15-01	
Upgrade SSH	03-01-01	04-30-01	
Web-server design	11-16-00	03-01-01	03-01-01
Web-server deployment in CV	03-01-01	04-30-01	
Purchase mirroring Web servers	04-30-01		
Web-server deployment in GB, NM, TU	07-31-01		
CCE design (to infrastructure level)	03-31-01	05-15-01	
Begin CCE-compliant UNIX upgrades	06-30-01		
Windows 2000 allowed	01-01-01	03-01-01	03-01-01
W2K Active Directory decision	06-01-01		
W2K domain design	09-01-01		

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 first quarter of 2001 was to bring the last remaining site, Tucson, into compliance with this requirement. This milestone has now been completed. While no measures can be 100% bulletproof in today's hostile Internet, the security environment that now prevails at the NRAO would have prevented essentially all of the previous intrusions we have experienced. This significant improvement has, furthermore, been achieved with minimal disruption to routine observer, staff, and operations activities.
Other security tasks currently planned or underway are:

1. Upgrading to a superior version of the SSH package under UNIX at all NRAO sites, including maintaining a central database of NRAO host keys: Considerable progress has been made on this task, such as selecting a standard list of configuration parameters for all sites; however, SSH-related security alerts during deployment required additional software upgrades, delaying completion until next quarter;
2. 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 and in support of telecommuting during construction at Edgemont Road in Charlottesville; and
3. Revising the Policy to accommodate special-purpose Web servers and VPN issues.

In addition, during the next six months we hope to begin examination of techniques to make status monitoring and intrusion detection manageable with the staff available.

During this past quarter, significant progress continued to be made on several major projects involving NRAO computer systems support staff. These projects include:

1. Planning for Windows 2000 deployment: All staff involved have now completed training in Windows 2000 and Active Directory. As a result of our improved understanding of the new operating system, the year-old moratorium on Windows 2000 workstations on NRAO networks was lifted at the beginning of March 2001. A design group is currently evaluating the costs and benefits of adopting Active Directory and will develop a domain design and migration plan following that evaluation.
2. Improving Web services: Design of the new mirror-compatible Web server layout is complete; the first of the new servers should be in production use in Charlottesville, serving www.nrao.edu and www.cv.nrao.edu , by the end of April 2001. In the coming quarter we plan to purchase and begin installation of three additional new servers at the remaining three sites which will similarly host both local site pages and a mirror of the main NRAO Web pages. The four mirrors of the primary NRAO Web site will allow load sharing and provide greatly increased reliability of access for our user community and the general public.
3. The Common Computing Environment project, or CCE: Common procedures for UNIX operating system installation and patching at all NRAO sites have been established, and a number of critical standards determined for the inter-site services which effect all networks at the NRAO. These processes will be used during the next major UNIX upgrades, to Solaris 8 and RedHat Linux 7.1, expected to begin at the end of the next quarter. In addition, several steps which would simplify unification of the NRAO site UNIX environments, in a manner similar to the Windows domain, have been taken. Although this is not an initial goal of the CCE project, it may prove to be beneficial in the future; CCE design decisions are therefore made with this possibility in mind.

Communications

Milestones	Original Date	Revised Date	Date Completed
AOC high-speed link	10-01-00	02-01-01	02-01-01
800 service switched to FTS2001	02-01-01		01-15-01
Satellite ISDN link to Chajnantor	02-01-01	06-30-01	
New Intranet contract	02-15-01	03-31-01	03-23-01
Third audio hub added	02-28-01		02-28-01
Upgrade video equipment software	03-31-01		03-24-01
Improved documentation for video conference use	04-30-01		
Proposal for additional video equipment	05-31-01		
Change long distance service in Green Bank	05-31-01		
Change long distance service in Tucson	05-31-01		
Decision on long distance service to VLBA sites	05-31-01		
Decision on Intranet contract for next years	12-31-01		

The major activity in the communications group has been the renegotiation of the contract that provides the frame relay intranet between the four major sites and six of the VLBA sites. From its inception, AT&T has provided this under the Federal Telecommunication Service 2000 (FTS2000) contract administered by the Government Services Administration (GSA). Unfortunately, AT&T was not one of the winning bidders to continue with the FTS2001 contract. Changing from AT&T would have meant changing over all circuits to a new carrier. Since we have inadequate resources to plan and execute this transition in 2001, it was essential to negotiate a new contract to use the same circuits. On our behalf, the Department of the Interior solicited bids for this service. The cost of the low bid represents a 35% increase in our costs compared to 2000. This contract was awarded to begin at the beginning of April. However, this cost is such a significant increase that we will be forced to re-evaluate the contract for subsequent years.

Following several 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 was completed at the end of January. This link is now operational and NRAO-NM is both sending and receiving traffic via Abilene.

The dedicated 800 service and the FTS2000 calling cards have been converted to the FTS2001 contract. We hope to be able to convert the services in Green Bank, Tucson, and those at the appropriate VLBA sites, plus commercial calling cards to FTS2001 in the coming quarter.

The ISDN satellite connection to the ALMA site in Chile has been undergoing tests between Tucson and Charlottesville. Progress was significantly delayed due to problems routing the calls between the different service providers involved in supplying the end-to-end connection. Although a small configuration issue has still to be resolved by the router manufacturer, the system has been shipped to Chile and should be installed in late May to begin on-site testing.

An essential upgrade of the software on the Polycom video telecommunication systems was done leading to much increased reliability of the services provided. Video conferencing is now in routine use between the major sites with at least 10 meetings per week taking advantage of the service. In addition, there are regular meetings with the Max Planck Institut fuer Radioastronomie (MPIfR) in Bonn, Germany using a dial-up ISDN connection. Video meetings have also been held between the NRAO and other overseas organizations such the European Southern Observatory (ESO) in Munich, Germany and others in Japan and in the USA. We are developing more experience in remote control of the facilities. A new software package will enhance our ability to share computer displays between all participants. An improved set of user instructions is being prepared.

A revised proposal is being prepared for additional video equipment at the major NRAO sites. In particular, this would allow much easier access to scientific colloquia between sites.

In order to cater for the increased number of audio conferences, a third audio hub was added in Charlottesville.

A new position to assist with the management of communications has been approved. We hope to fill this position in the coming quarter.

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)	1665.1	1224.2
Scheduled Maintenance and Equipment Changes	216.4	172.0
Scheduled Tests and Calibration	268.5	242.5
Time Lost	69.2	60.8
Actual Observing	1595.9	1163.4

VLA Observing Programs

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

No.	Observer(s)	Programs
AA250	Augusto, P. (Madeira) Gonzales-Serrano, I. (Cantabria) Gizani, N. (Madeira) Edge, A. (Durham) Perez-Fournon, I. (Laguna)	Core identification in large compact symmetric objects. 1.3 cm
AB1005	Blomme, R. (Royal Obs)	Current flux of 9 Sgr. 20, 6, 2.6 cm
AB876	Bietenholz, M. (York U.) Frail, D. Hester, J. (Arizona State)	Time variability in the radio structure of the crab nebula. 6 cm
AB917	Blundell, K. (Oxford) Beasley, A.J. (OVRO) Close, L. (Oxford) Leahy, P. (Manchester)	Multi-frequency high resolution study of hotspots: the key to understanding how classical double radio sources work. 7,1.3,2,90 cm
AB950	Becker, R. (UC, Davis) White, R. (STScI) Helfand, D. (Columbia)	The FIRST survey. 20 cm
AB969	Brisken, W. (Princeton) Thorsett, S. (UC, Santa Cruz) Goss, W.M.	Proper motion of the "Duck" pulsar B1757-24. 20 cm
AB971	Brand, J. (Bologna) Wouterloot, J. (Bonn U.)	Very young UC HII regions WB89 380 and WB89 437. 1.3, 2, 3.6 cm

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)	NOAO deep wide field survey at 90 cm.
AB977	Braatz, J. Greenhill, L. (CfA) Sand, D. (Caltech)	Maser disk in IC 1481. 1.3 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
AB982	Blundell, K. (Oxford) Dubner, G. (IAFE) Mioduszewski, A. (Sydney) Kassim, N. (NRL)	Imaging the W50-SS433 system at 74 MHz. 400 cm
AB984	Bolton, S. (JPL) Sault, R. (CSIRO) Levin, S. (JPL) Klein, M. (JPL) Bastian, T. Leblanc, Y. (Paris Obs) Dulk, G. (Paris Obs) Roller, J. (Lewis Center) McLeod, R. (Lewis Center)	Multi-frequency radio observations of Jupiter. 20, 90 cm

AB987	Bower, G. (UC,Berkeley) Falcke, H. (MPIR, Bonn) Brunthaler, A. (MPIR, Bonn) Mellon, R. (Penn State)	Linear and circular polarization of M81
AB988	Bietenholz, M. (York U.) Frail, D. Bartel, N. (York U.) Hester, J. (Arizona State)	Radio movie of the Crab nebula. 6 cm
AB989	Berger, E. (Caltech)	Radio survey of bona fide and candidate brown dwarfs. 3.6 cm
AB991	Brown, A. (CASA) Osten, R. (CASA) Ayres, T. (CASA) Harper, G. (CASA) Guinan, E. (Villanova)	Time-resolved Coronal Chandra +VLA observations of the RS CVn binary ER vul.
AC467	Colina, L. (IFCA) 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
AC560	Claussen, M. Brogan, C. Desai, K. (Renaissance Tech) Goss, W.M.	Scattering in the direction of 1720 MHz OH masers in W28. 6, 18, 20 cm

AC562	Curiel, S. (Mexico/UNAM) Trinidad, M. (Mexico/UNAM) Torrelles, J. (IAA, Andalucia) Canto, J. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Gomez, J. (IAA, Andalucia) Ho, P. (CfA)	Radio jet/water maser systems around YSOs. 1.3 cm
AC583	Clarke, T. Enslin, T. (MPIAP, Munich) Kassim, N. (NRL) Neumann, D. (CNRS, France)	Low frequency observations of diffuse emission in Abell 2256. 90, 400 cm
AC592	Condon, J.J. Jarrett, T. (IPAC) Helou, G. (IPAC)	The second "taffy" galaxy pair. 20 cm
AD432	Dunlop, J. (Edinburgh) Ivison, R. (U. College London) Rowan-Robinson, M. (Imperial College) Longair, M. (Cambridge) Hughes, D. (INAOE, Mexico) Blain, A. (Cambridge)	UK SCUBA deep field. 20 cm
AD438	Dennett-Thorpe,J. (Groningen/Kapteyn) de Bruyn, A. (NFRA)	A microarcsecond scintilator. 1.3, 3.6, 6 cm
AD440	Van Dyk, S. (IPAC)	Searching for radio supernovae in Wolf-Rayet galaxies. 6, 20 cm
AD441	Dwarakanath, K. (Raman Institute) Kassim, N. (NRL) Owen, F. Perley, R.	The radio halo of Virgo A at 74 MHz. 400 cm

AD447	Drake, C. (Mt. Stromlo) McGregor, P. (Mt. Stromlo) Norris, R. (CSIRO) Bicknell, G. (Mt. Stromlo) Dopita, M. (Mt. Stromlo)	High resolution imaging of intermediate radio loud IRAS galaxies. 1.3, 3.6, 6, 20 cm
AD448	Doi, A. (Tokyo U.) Kohno, K. (NAO, Japan) Kameno, S. (NAO, Japan)	Search for high gigahertz peaked radio core in Seyfert galaxies. 0.7, 1.3, 3.6, 6, 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
AF377	Fassnacht, C. (STScI) Rusin, D. (Pennsylvania) Xanthopoulos, E. (Manchester) Koopmans, L. (Caltech)	Monitoring of JVAS and CLASS gravitational lenses. 2, 3.6, 6 cm
AF380	Filho, M. (Groningen/Kapteyn) Goudfrooij, P. (STScI) Barthel, P. (Groningen/Kapteyn)	Sources of ionization in early type liner galaxies. 3.6 cm
AF381	Fish, V. (CfA) Reid, M. (CfA)	HII regions associated with OH masers. 2, 6 cm
AF382	Fish, V. (CfA) Reid, M. (CfA)	Resolving kinematic distance ambiguities for OH maser/HII regions. 20 cm
AF383	Fomalont, E. Kellermann, K. Rossi, P. (MPIfEP, Garching) Shaver, P. (ESO)	Chandra Deep Field South. 6, 20 cm

AG578	Greenhill, L. (CfA) Moran, J. (CfA) Reid, M. (CfA) Holder, B. (CfA)	Water masers in the Orion BN/KL region. 1.3 cm line
AG589	Gudel, M. (Paul Scherrer)	Bright stellar coronae observed with XMM. 3.6, 6 cm
AH669	Rupen, M. Mioduszewski, A.	Continued study of radio and x-ray activity in galactic black hole transients. 20,6,3.6,2,1.3 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 line
AH714	Hardcastle, M. (Bristol, UK)	Jets and the emission line gas around 3C171. 1.3, 2 cm
AH717	Hardcastle, M. (Bristol, UK) Sakelliou, I. (MRAO)	Jets and their termination in wide angle tail radio galaxies. 3.6 cm
AH726	Hatchell, J. (MPIR, Bonn) Thompson, M. (Kent)	High mass SCUBA cores - with or without HII regions? 2, 6 cm
AH729	Han, J. (Beijing Obs) Liang, H. (Bristol, UK) Chen, Y. (Beijing Obs)	NVSS sources of the strongest linear polarization. 20 cm
AH730	Harris, D. (CfA) Siemiginowska, A. (CfA)	Radio/x-ray jet in PKS 1127-145. 3.6, 20 cm
AH733	Healy, K. (Arizona State) Claussen, M. Hester, J. (Arizona State)	Water maser activity in young low-mass stars in HII regions. 1.3 cm

AH734	Hachisuka, K. (NAO, Japan) Umemoto, T. (NAO, Japan) Horiuchi, S. (NAO, Japan) Miyoshi, M. (NAO, Japan) Mochizuki, N. (Nobeyama Obs)	Accurate positions of outer galaxy water masers. 1.3 cm
AH736	Hagiwara, Y. (MPIR, Bonn) Henkel, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Nakai, N. (NAO, Japan)	Water maser emission in M51. 1.3 cm line
AH737	Hardcastle, M. (Bristol, UK)	X-ray detected hot spot in 3C 263. 2 cm
AI084	Ivison, R. (U. College London) Dunlop, J. (Edinburgh) Smail, I. (Durham) Jenner, C. (U. College London) Dey, A. (KPNO-NOAO)	Surveying the fields of high redshift radio galaxies. 20 cm
AI085	Ishihara, Y. (NAO, Japan) Nakai, N. (NAO, Japan) Sato, N. (NAO, Japan) Diamond, P. (Manchester)	Determining positions of water maser emission in AGN. 1.3 cm
AI088	Ivison, R. (U. College London) Papadopoulos, P. (Leiden) Carilli, C. Barvainis, R. (NSF) Lewis, G. (AAO)	CO J=1-0 and J=2-1 mapping of the z=3.9 quasar APM 08279+5255. 1.3 cm
AJ277	Johnston, K. (USNO) Fey, A. (USNO) Gaume, R. (USNO) Claussen, M.	Astrometric and polarization measurements of the T Tau system. 0.7, 1.3, 2, 3.6, 6 cm
AK496	Kronberg, P. (Toronto) Sramek, R. Allen, M. (Toronto) Birk, G. (Munich)	Extending the M82 compact source monitoring to 19 years. 6 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.
AK518	Koopmans, L. (Caltech) de Bruyn, A. (NFRA) Fassnacht, C. (STScI) Wambsganss, J. (API, Potsdam) Blandford, R. (Caltech)	Radio micro lensing in B 1600+434. 2, 3.6, 6, 20 cm
AK527	Kobulnicky, C. (Wisconsin) Johnson, K. (Colorado/JILA) Gallagher, J. (Wisconsin) Conti, P. (Colorado/JILA) Tan, J. (UC, Berkeley) Churchwell, E. (Wisconsin)	Optically thick free-free sources in Henize 2-10. 1.3 cm
AK528	Kwok, S. (Calgary)	Radio morphologies of planetary nebulae. 3.6 cm
AK530	Kaplan, D. Caltech) Kulkarni, S. (Caltech) Frail, D.	Anomalous X-ray pulsars. 20 cm
AK531	Kaplan, D. (Caltech) Kulkarni, S. (Caltech) Frail, D.	The nearest neutron stars. 20 cm
AK533	Kempner, J. (Virginia) Sarazin, C. (Virginia) Rudnick, L. (Minnesota)	Cluster radio relics discovered in WENSS. 20, 90 cm
AL525	Lim, J. (SA/IAA, Taiwan) Carilli, C. White, S. (Maryland)	Resolving red supergiant stars. 0.7, 1.3 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, 400 cm
AL532	Londish, D. (Sydney) Sadler, E. (Sydney) Boyle, B. (AAO) Croom, S. (AAO)	Optically selected BL Lacs. 6 cm
AL533	Lang, C. (Massachusetts) Goss, W.M. Zhao, J-H. (CfA) Rodriguez, L. (Mexico/UNAM)	The Sgr A* stellar cluster. 0.7 cm
AL537	Leon, S. (ASIAA)	Ultraluminous infrared galaxies in multiple interactions. 3.6 cm
AL538	Laing, R. (Oxford) Canvin, J. (Oxford) Bridle, A. Cotton, W.D. Giovannini, G. (Bologna)	Rotation measure of the jets in NGC 315. 20 cm
AL539	Liszt, H.	Cold HI in the inner galaxy. 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

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 FRI radio galaxies. 20 cm line
AM673	Mohan, N. (Raman Institute) Anantharamaiah, K. (Raman Institute) Goss, W.M.	Search for free-free absorption in Starburst nuclei at 330 MHz. 90 cm
AM676	Morrison, G. (IPAC) Ledlow, M. (KPNO-NOAO) Owen, F. Dressler, A. (Mt. Wilson) Oemler, A. (Mt. Wilson)	Star formation in the richest Abell clusters. 20 cm
AM677	Mundell, C. (Liverpool JMU) Ferruit, P. (Lyon) Friedli, D. (Geneva) Martin, P. (CFHT, Hawaii) Sheth, K. (Maryland)	Gas dynamics in barred galaxies. 20 cm
AM678	Mihos, C. (Case Western Reserve) van Gorkom, J. (Columbia) Chang, T. (Columbia) Zabludoff, A. (Arizona) Zaritsky, D. (Arizona)	EA1: a post starburst galaxy in an ongoing merger? 20 cm
AN095	Neff, S. (NASA/GSFC) Ulvestad, J.	Star formation in merging galaxies: an age ordered sequence. 3.6, 6 cm
AN098	Nagar, N. (Maryland) Wilson, A. (Maryland) Falcke, H. (MPIR, Bonn)	Census of accreting black holes in nearby galaxies. 2, 3.6 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. (KPNO-NOAO)	Extremely deep survey of the CL 0939+47 field. 20 cm
AO157	Omar, A. (Raman Institute) Anantharamaiah, K. (Raman Institute) Rupen, M.	OH in water mega maser galaxies. 20 cm
AP395	Perlman, E. (STScI) Landt, H. (STScI) Padovani, P. (STScI)	X-ray bright flat spectrum radio quasars. 20 cm
AP397	Perley, R. Condon, J.J. Cotton, W.D. Yin, Q. Wall, J. (Oxford) Kassim, N. (NRL) Erickson, W. (Maryland)	4 Meter all-sky survey: Test observations. 400 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. 20, 90, 400 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
AR452	Rottgering, H. (Leiden) Schoenmakers, A. (NFRA) Best, P. (Royal Obs) Kassim, N. (NRL) Perley, R. Pierre, M. (CNRS, France) Regrigier, A. (CNRS, France) Rengelink, R. (Leiden) Birkinshaw, M. (Bristol, UK) Bremer, M. (Bristol, UK) Liang, H. (Bristol, UK) Zanichelli, A. (Milano Obs)	Radio source population and the XMM large scale structure survey. 90 cm
AR455	Rawlings, S. (Oxford) Dalton, G. (Oxford) Blake, C. (Oxford) Wegner, G. (Dartmouth)	Radio imaging of Oxford Wide field camera study. 20 cm
AR457	Roy, S. (NCRA, India) Rao, A. (NCRA, India)	Rotation measure observations of sources near the Galactic center. 3.6, 6 cm
AR458	Rupen, M. Mioduszewski, A. (Sydney) Dhawan, V.	Radio and X-ray activity in Galactic black hole X-ray transients. 0.7, 1.3, 2, 3.6, 6, 20 cm

AR460	Reese, E. (Chicago) Carlstrom, J. (Chicago)	Point source survey of galaxy cluster fields. 3.6, 6 cm
AS568	Sramek, R. Weiler, K. (NRL) VanDyk, S. (UCLA) Panagia, N. (STScI)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS687	Soifer, B. (Caltech) Helou, G. (IPAC) Werner, M. (JPL) Shupe, D. (Caltech) Storrie-Lombardi, L. (Caltech) Condon, J.J. Cotton, W.D.	The SIRTF First-look survey. 20 cm
AS696	Su, Y. (NCU, Taiwan) Lim, J. (SA/IAA, Taiwan) Ho, P. (CfA)	Water masers associated with High mass protostars. 1.3 cm
AS701	Sokoloski, J. (Southampton) Kaiser, C. (MPIfEP, Garching) Charles, P. (Southampton)	Symbiotic binaries during outburst. 3.6, 6, 20 cm
AS704	Saunders, R. (Cambridge) Cotter, G. (RGO) Jones, M. (Cambridge) Grainge, K. (Cambridge) Pooley, G. (Cambridge) Waldram, E. (Cambridge) Taylor, A. (Cambridge)	SEDs of sources from the Cambridge 15 - GHz survey. 0.7, 1.3, 6, 20 cm
AS707	Shinnaga, H. (SA/IAA, Taiwan) Lim, J. (SA/IAA, Taiwan) Dinh, V. (SA/IAA, Taiwan) Claussen, M. Tsuboi, M. (Ibaraki U.)	SiO masers in the peculiar supergiant VY CMa. 0.7 cm

AT236	Troland, T. (Kentucky) Crutcher, R. (Illinois) Plante, R. (Illinois) Roberts, D. (Brandeis)	OH Zeeman measurements in the central few parsecs of galaxy. 20 cm line
AV249	de Vicente, P. (Yebes Obs) Martin-Pintado, J. (Yebes Obs) Gaume, R. (USNO) DePree, C. (Agnes Scott College)	Sgr B2N: Youngest cluster of massive stars in the galaxy. 0.7 cm
AW551	Winn, J. (MIT) Lovell, J. (CSIRO) Hewitt, J. (MIT) Patnaik, A. (MPIR, Bonn) Edwards, P. (ISAS, Japan) Jauncey, D. (CSIRO)	Southern gravitational lens candidates. 2, 3.6 cm
AW556	Willson, R. (Tufts) van Driel-Gestelyi, L. (Paris Obs) Klein, K. (Paris Obs) Bentley, R. (U. College London)	Collaborative observations of Type I noise storms. 20, 90 cm
AW557	Willson, R. (Tufts) van Driel-Gestelyi, L. (Paris Obs) Klein, K. (Paris Obs)	Decametric type III bursts and their relationship to noise storms. 400 cm
AY121	Yun, M. (Massachusetts) Sanders, D. (Hawaii) Kawara, K. (Tokyo U.) Taniguchi, Y. (Tohoku)	The Lockman Hole ROSat/XMM/ISO deep survey field. 20 cm
AY122	Yusef-Zadeh, F. (Northwestern) Cotton, W.D.	Wide field 20 cm imaging of the inner degree of 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

BB129	Brogan, C. Claussen, M. Goss, W.M.	VLBA Zeeman observations of OH masers associated with SNRs
BC111	Cotton, W.D. Mennesson, B. (Leiden) Vlemmings, W. (Leiden) Perrin, G. (Paris Obs) Coude du Foresto, V. (Paris Obs) Chagnon, G. (Paris Obs) Diamond, P. (Manchester) van Langevelde, H. (NFRA) Ridgway, S. (KPNO-NOAO) Morel, S. (CfA) Traub, W. (CfA) Carleton, N. (CfA) Lacasse, M. (CfA) Waters, R. (Amsterdam)	Bright O-rich Mira stars. 0.7 cm single antenna VLBI
BD069	Diamond, P. (Manchester) Kemball, A.	TX Cam: the final curtain
BG097	Gudel, M. (Paul Scherrer Institute Beasley, A.J. (OVRO) Benz, A.O. (IoA) Brinkman, A. (SRON) Mewe, R. (SRON Savin, D. (Columbia)	Energy release in stellar coronae (XMM key project)
BG098	Greenhill, L. (CfA) Diamond, P.J. (Manchester) Moran, J. (CfA)	Maser motions and outflow in a solar system sized region around a 10.

BG113	Gomez, J.L. (IAA, Granada) Marscher, A.P. (Boston) Marchenko-Jorstad, S. (Boston) Alberdi, A. (IAA, Granada) Agudo, I. (IAA, Granada) Marti, J. (Valencia) Aloy, M. (Valencia) Ibanez, J. (Valencia)	Flashing superluminal components in 3C120.
BG118	Greenhill, L. (CfA) Chandler, C. Diamond, P. (Manchester) Moran, J. (CfA) Reid, M. (CfA)	SiO maser motions in Orion BN/KL. 0.7 cm single antenna VLBI
BK078	Kellermann, K. Vermeulen, R. (NFRA) Zensus, A. (MPIR, Bonn) Cohen, M. (Caltech)	1345+125: an unusual AGN with a double nucleus and strong CO. 2, 6 cm
BR071	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)	Astrometry of HR 8703 in 2001 for the Gravity Probe-B mission. 2, 3.6, 6 cm
BV039	Vermeulen, R. (NFRA) Taylor, G.	Broad HI in the CSO 0428+205. 18 cm
BV041	Venturi, T. (CNR, Bologna) Comastri, A. (Bologna) Fiore, F. (Rome) Morganti, R. (NFRA) Pellegrini, S. (Bologna)	Probing the accretion process in the nucleus of the radio galaxy PKS 1333-33.

BY012	Yi, J. (Onsala) Booth, R.S. (Onsala) Winnberg, A. (Onsala) Humphreys, E. (Onsala) Conway, J. (Onsala) Diamond, P.J. (Manchester)	Further observations of v=1 and 2 43 GHz SiO masers in two Mira variables.
GB036	Bartel, N. (York U.) Bietenholz, M. (York U.)	SN 1979C in M100 in Virgo. 18 cm
GM038	McDonald, A. (Manchester) Pedlar, A. (Manchester) Muxlow, T. (Manchester) Diamond, P. (Manchester) Wills, K. (Sheffield) Wilkinson, P. (Manchester) Garrett, M. (NFRA)	Second-epoch observations of compact supernova remnants in M82. 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

GM041	Morganti, R. (NFRA) Oosterloo, T. (NFRA) Vermeulen, R. (NFRA) Pihlstrom, Y. (Chalmers, Onsala) van Moorsel, G. Tadhunter, C. (Sheffield) Wills, K. (Sheffield)	Neutral hydrogen absorption in far IR starbursting radio galaxies. 18 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
GX007	Xanthopoulos, E. (Manchester) Browne, I. (Manchester) Wilkinson, P. (Manchester) Patnaik, A. (MPIR, Bonn) Porcas, R. (MPIR, Bonn)	JVAS gravitational lens B1030+074. 0.7, 18 cm

VLBA Observing Programs

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

No.	Observer(s)	Programs
BA048	Augusto, P. (Madeira) Edge, A. (Durham) Gonzalez-Serrano, I. Perez-Fournon, I.	Core identification in large compact symmetric objects and medium symmetric objects. 6, 20 cm
BB121	Bower, G. (UC,Berkeley)	Probing small scale structure in galactic molecular gas with the VLBA. 3 cm
BB129	Brogan, C. Claussen, M. Goss, W.M.	VLBA Zeeman observations of OH masers associated with SNRs. 20 cm
BB132	Brunthaler, A. (CfA) Falcke, H. (MPIR, Bonn) Henkel, C. (MPIR, Bonn) Reid, M. (CfA)	First epoch observations for extragalactic proper motions in the local group with the VLBA. 1 cm
BB133	Biggs, A. (Manchester) Norbury, M. (Manchester) Browne, I. (Manchester) Koopmans, L. (Caltech) Norbury, M. (Manchester) Rusin, D. (Pennsylvania)	Search for superluminal motion in two CLASS gravitational lens systems. 1 cm
BC104	Chatterjee, S. (Cornell) Cordes, J. (Cornell) Goss, W.M. Fomalont, E. Beasley, A. (OVRO) Benson, J. Lazio, T. (NRL) Arzoumanian, Z. (NASA/GSFC)	High frequency VLBA pulsar astrometry. 6 cm

BC111	Cotton, W. D. Mennesson, B. (Leiden) Vlemmings, W. (Leiden) Perrin, G. (Paris Obs) Coude du Foresto, V. (Paris Obs) Chagnon, G. (Paris Obs) Diamond, P. (Manchester) van Langevelde, H. (NFRA) Ridgway, S. (KPNO-NOAO) Morel, S. (CfA) Traub, W. (CfA) Carleton, N. (CfA) Lacasse, M. (CfA) Waters, R. (Amsterdam)	Bright O-rich Mira stars. 0.7 cm
BC114	Clark, T. (NASA/GSFC) Ma, C. (NASA/GSFC) Johnston, K. (USNO) Fey, A. (USNO) Gordon, D. (NASA/GSFC) Gaume, R. (USNO) Boboltz, D. (USNO) Kingham, K. (USNO) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) Shaffer, D. (Radiometrics) Fomalont, E. Walker, C.	VLBA Geodesy/Astrometry observations for 2001. 3.6 cm
BD069	Diamond, P. (Manchester) Kemball, A.	TX Cam: the final curtain. 0.7 cm
BF064	Fish, V. (CfA) Argon, A. (CfA) Menten, K. (MPIR, Bonn) Reid, M. (CfA)	Magnetic fields in massive star forming regions. 20 cm
BF067	Fassnacht, C. (STSCI)	Structure in gravitational lens CLASS B1608+656. 3.6 cm

BG097	Gudel, M. (SFIT, ETH) Audard, M. (SFIT, ETH) Beasley, A. (OVRO) Benz, A. (SFIT, ETH) Brinkman, A. (Utrecht) Mewe, R. (Utrecht) Savin, D. (Columbia)	Bright RS CVn sources during XMM observations. 3.6, 6 cm
BG098	Greenhill, L. (CfA) Diamond, P. (Manchester) Moran, J. (CfA)	Maser motions in Orion BN/KL. 0.7 cm
BG099	Gomez, J. (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
BG102	Gallimore, J. Baum, S. (STScI) Kukula, M. (Edinburgh) Murray, C. (UNM) O'Dea, C. (Baltimore) Pedlar, A. (NRAL) Thean, A. (Bologna)	VLBA Observations of the CfA Seyferts. 13 cm
BG111	Gallimore, J.	Possible new radio supernova in the merger remnant NGC 6240. 2 cm
BG113	Gomez, J. (IAA, Andalucia) Marscher, A. (Boston) Marchenko-Jorstad, S. (Boston) Alberdi, A. (IAA, Andalucia) Agudo, I. (IAA, Andalucia) Marti, J. (U. Jaen) Aloy, M. (Valencia) Ibanez, J. (Valencia)	Monitoring superluminal components in 3C120. 0.7, 1.3, 2 cm

BG118	Greenhill, L. (CfA) Chandler, C. Diamond, P. (Manchester) Moran, J. (CfA) Reid, M. (CfA)	SiO maser motions in Orion BN/KL. 0.7 cm
BH077	Hachisuka, K. (Graduate University) Fujisawa, K. (NAO) Honma, M. (NAO) Imai, H. (NAO) Kameya, K. (NAO) Manabe, S. (NAO) Miyoshi, M. (NAO) Mochizuki, N. (Graduate University) Nisio, M. (Kagoshima) Omodaka, T. (Kagoshima) Sasao, T. (NAO) Sawada-Satoh, S. (NAO)	Detecting an annual parallax of water masers in W3 (OH). 1 cm
BH080	Hough, D. (Trinity University)	Variability in the nuclei of lobe-dominated quasars. 4 cm
BI021	Inoue, M. (NAO) Asada, K. (NAO) Fujisawa, K. (NAO) Kameno, S. (NAO) Mutou, M. (NAO)	Detection of asymmetric polarization features in GPS radio sources. 2, 4, 6 cm
BJ036	Jorstad, S. (Boston) Marscher, A. (Boston) Yurchenklo, A. (St. Petersburg)	BL Lac objects with high proper motion. 1, 2, 4 cm
BJ037	Jones, D. (JPL) Dressel, L. (STScI) Wehrle, A. (IPAC)	Search for free-free absorption on sub-parsec scales in the nuclei of NGC 3998 and NGC 7052. 6, 13, 20 cm

BK068	Kellermann, K. Cohen, M. (Caltech) Vermeulen, R. (NFRA) Zensus, J. A. (MPIR, Bonn)	Kinematics of quasars and AGN. 2 cm
BK076	Kurayama, T. (NAO) Sasao, T. (NAO)	Parallax measurement of Miras for period-luminosity relation. 1 cm
BK078	Kellermann, K. Vermeulen, R. (NFRA) Zensus, J. A. (MPIR, Bonn) Cohen, M. (Caltech)	1345+125: an unusual AGN with a double nucleus and strong CO. 2, 6 cm
BK083	Kondratko, P. (CfA) Greenhill, L. (CfA) Moran, J. (CfA)	Does starburst/water megamaser galaxy NGC 3079 have an AGN? 1.3, 2, 3.6, 6 cm
BL088	Lazio, J. (NRL) Chatterjee, S. (Cornell) Cordes, J. (Cornell) Fey, A. (USNO)	Intergalactic radio-wave scattering. 90 cm
BL095	Lister, J. (JPL) Piner, B. (JPL)	Completion of the Pearson-Readhead AGN VLBI survey using phase referencing. 6 cm
BL099	Langston, G. Avruch, I. (NFRA) Minter, A. Perlman, E. (STScI)	Monitoring PKS 1413+135 for superluminal motion and spectral evolution. 2, 4, 6 cm
BM132	Migenes, V. (Guanajuato) Altunin, V. (JPL) Horiuchi, S. (NAO) Ludke, E. (Santa Maria) Mendoza, E. (INAOE) Slysh, S. (Lebedev)	Search for small angular sized OH maser regions. 20 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. (IAA, Andalucia) Smith, P. (KPNO-NOAO) Forster, J. (UC, Berkeley) Yurchenko, A. (St. Petersburg)	Bright millimeter sources. 0.7 cm
BM139	Minier, V. (Onsala) Booth, R. (Onsala) Ellingsen, S. (Tasmania) Norris, R. (ATNF)	Proper motion studies of 12.2 GHz methanol masers. 2 cm
BM142	Marcaide, J. (Valencia) Guirado, J. (Valencia) Perez-Torres, M. (Bologna) Ros, E. (MPIR, Bonn)	Multi-wavelength absolute kinematics in the S5 polar cap sample. 0.7, 2, 3.6 cm
BM152	Marecki, A. (Torun) Spencer, R. (Manchester)	Study of very compact steep spectrum objects - Part II. 20 cm
BM153	Marr, J. (Union College) Dennett-Thorpe, J. (Kapteyn) Polatidis, A. (Onsala)	VLBI structure of the faint GPS and ULIR source 0524+010. 6,4 cm

BN016	Norbury, M. (Manchester) Phillips, P. (Manchester) Jackson, N. (Manchester) Browne, I. (Manchester) Wilkinson, P. (Manchester) Koopmans, L. (Caltech) Rusin, D. (Pennsylvania) Myers, S. Marlow, D. (Pennsylvania) Blandford, R. (Caltech) Fassnacht, C. (STScI) Pearson, T. (Caltech) Readhead, T. (Caltech)	Snapshot observations of CLASS lens candidates. 2, 6 cm
BP072	Palmer, P. (Chicago) Goss, W.M.	VLBA observations of 2II 1/2,J=1/2 OH in galactic sources. 6 cm
BR071	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)	Astrometry of HR 8703 in 2001 for the Gravity Probe-B mission. 2, 3.6, 6 cm
BR076	Reid, M. (CfA) Shapiro, I. (CfA)	Target of opportunity for a SNR candidate in NGC 7469. 4 cm
BS085	Stanghellini, C. (Noto) Baum, S. (STScI) Dallacasa, D. (Bologna) Fanti, C. (Bologna) Fanti, R. (Bologna) O'Dea, C. (STScI) Perez-Torres, M. (Bologna)	Observations of gigahertz-peaked spectrum radio sources. 20, 6, 4, 2, 1 cm
BS086	Sjouwerman, L. (JIVE) Dickel, J. (Illinois) Garrett, M. (JIVE)	Extragalactic background calibrators around M31. 4, 6, 20 cm

BS087	Sudou, H. (Tohoku Univ.) Iguchi, S. (NAO) Murata, Y. (ISAS) Taniguchi, Y. (Tohoku Univ.)	Phase referencing VLBI observations of 3C 66B. 1, 4, 13 cm
BS089	Sudou, H. (Tohoku Univ.) Taniguchi, Y. (Tohoku Univ.) Kaburaki, O. (Tohoku Univ.) Ohyama, Y. (NAO, Japan) Sawada-Satoh, S. (NAO, Japan) Inoue, M. (NAO, Japan) Kameno, S. (NAO, Japan)	Mapping the core region of NGC 6251. 1.3, 2 cm
BT055	Taylor, G. Peck, A. (MPIR, Bonn) Wilkinson, P. (Manchester) Vermeulen, R. (NFRA) Polatidis, A. (NFRA)	Pinpointing the cores in compact symmetric objects. 2 cm
BU020	Ulvestad, J. Ho, L. (Carnegie Inst.) Teng, S. (Maryland)	Nuclear absorption in Palomar Seyfert galaxies. 4, 6, 13 20 cm
BV039	Vermeulen, R. (NFRA) Taylor, G.	Broad HI in the CSO 0428+205. 18 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. 20 cm
BV041	Venturi, T. (Bologna) Comastri, A. (Bologna) Fiore, F. (Rome Obs) Morganti, R. (NFRA) Pellegrini, S. (Bologna)	Radio galaxy PKS B1333-33. 1.3, 2, 3.6 cm

BW053	Winn, J. (MIT) Cohen, A. (MIT) Hewitt, J. (MIT)	Model constraints for a new flat-spectrum gravitational lens. 4 cm
BW054	Walker, R.C. Wrobel, J.	Jet collimation regions. 7 cm
BY012	Yi, J. (Chalmers, Onsala) Booth, R. (Chalmers, Onsala) Winnberg, A. (Chalmers, Onsala) Humphreys, E. (Chalmers, Onsala) Conway, J. (Chalmers, Onsala) Diamond, P. (Manchester)	v=1 and v=2 SiO masers in Mira variables R Cas and TX Cam. 0.7 cm
BZ025	Zheng, X. (Nanjing) Moran, J. (CfA) Reid, M. (CfA)	Proper motions of OH masers in G34.3+0.2 and NGC 7538. 20 cm
GB036	Bartel, N. (York U.) Bietenholz, M. (York U.)	SN 1979C in M100 in Virgo. 18 cm
GG045	Gizani, N. (Madeira) Garrett, M. (NFRA) Leahy, J. (Manchester)	Probing the parsec scale environment of 3C310. 18 cm
GM038	McDonald, A. (Manchester) Pedlar, A. (Manchester) Muxlow, T. (Manchester) Diamond, P. (Manchester) Wills, K. (Sheffield) Wilkinson, P. (Manchester) Garrett, M. (NFRA)	Second-epoch observations of compact supernova remnants in M82. 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 at 6 and 18 cm. 6 cm
GM041	Morganti, R. (NFRA) Oosterloo, T. (NFRA) Vermeulen, R. (NFRA) Pihlstrom, Y. (Chalmers, Onsala) van Moorsel, G. Tadhunter, C. (Sheffield) Wills, K. (Sheffield)	Neutral hydrogen absorption in far IR starbursting radio galaxies. 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

GX007	Xanthopoulos, E. (Manchester) Browne, I. (Manchester) Wilkinson, P. (Manchester) Patnaik, A. (MPIR, Bonn) Porcas, R. (MPIR, Bonn)	JVAS gravitational lens B1030+074. 0.7, 18 cm

Personnel

NEW HIRES

Behrens, George	Electronics Engineer I (Temporary)	2/07/01
Brito, Rodrigo	Jr Eng Associate	3/13/01
Lister, Matthew	Research Associate	1/01/01
Patt, Ferdinand	Electronics Engineer II	1/02/01
Thomas, Nathan	Jr Eng Associate	1/03/01
Urbain, Denis	Electronics Engineer II	3/05/01

TERMINATIONS

Sizemore, Nathaniel	Research Assistant	1/12/01

PROMOTIONS

Muehlberg, James	Electronics Engineer III	1/01/01
Perley, Margaret	Division Head/Array Operations	2/01/01
Ulvestad, James	Scientist-Head/Scientific Services	1/01/01

OTHER

D'Addario, Larry	to Leave of Absence	2/01/01
Gordon, Mark	return from Leave of Absence	2/01/01
Pospieszalski, Marian	to Leave of Absence	3/01/01
Yin, Quifeng	from Part-time to Full-time status	1/01/01

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, JANUARY - MARCH 2001

BELTRAN, M.T.; ESTALELLA, R.; ANGLADA, G.; RODRIGUEZ, L.F.; TORRELLES, J.M. Radio Spectral Indices of the Powering Sources of Outflows.

BIGGS, A.D.; BROWNE, I.W.A.; WILKINSON, P.N. Intrinsic Intraday Variability in the Gravitational Lens System B0218+357.

CHANDLER, C.J.; RICHER, J.S. Sub-arcsecond Imaging of SiO in the HH 211 Protostellar Jet.

DALE, D.A.; GIOVANELLI, R.; HAYNES, M.P.; HARDY, E.; CAMPUSANO, L.E. Signatures of Galaxy-Cluster Interactions: Spiral Galaxy Rotation Curve Asymmetry, Shape, and Extent.

DESAI, K.M.; FEY, A.L. Anisotropic Interstellar Scattering Towards the Cygnus Region.

DIAZ, A.I.; HARDY, E. The Evolution of Stellar Populations.

DOELEMAN, S.; SHEN, Z.-Q.; ROGERS, A.E.E.; BOWER, G.C.; WRIGHT, M.C.H.; ZHAO, J.H.; BACKER, D.C.; CROWLEY, J.W.; FREUND, R.W.; HO, P.T.P.; LO, K.Y.; WOODY, D.P. Structure of Sagittarius A* at 86 GHz Using VLBI Closure Quantities.

DYER, K.K.; GOSS, W.M.; KEMBALL, A.J. Australia Telescope Compact Array Observations of the OH Star Roberts 22: Resolved Images of OH Emission.

FENDER, R.P.; HJELLMING, R.M.; TILANUS, R.P.J.; POOLEY, G.G.; DEANE, J.R.; OGLEY, R.N.; SPENCER, R.E. Spectral Evidence for a Powerful Compact Jet from XTE J1118+480.

GARRETT, M.A.; MUXLOW, T.W.B.; GARRINGTON, S.T.; ALEF, W.; ALBERDI, A.; VAN LANGEVELDE, H.J.; VENTURI, T.; POLATIDIS, A.G.; KELLERMANN, K.I.; BAAN, W.A.; KUS, A.; WILKINSON, P.N.; RICHARDS, A.M.S. AGN and Starbursts at High Redshift: High Resolution EVN Radio Observations of the Hubble Deep Field.

GIOVANNINI, G.; COTTON, W.D.; FERETTI, L.; LARA, L.; VENTURI, T. VLBI Observations of a Complete Sample of Radio Galaxies. 10 Years Later.

GORDON, M.A.; HOLDER, B.P.; JISONNA, L.J.; JORGENSON, R.A.; STRELNITSKI, V.S. Three-Year Monitoring of Millimeter-Wave Radio Recombination Lines from MWC349.

HARPER, G.M.; BROWN, A.; LIM, J. A Spatially-Resolved, Semi-empirical Model for the Extended Atmosphere of alpha Orionis (M2 Iab)

HO, L.C.; ULVESTAD, J.S. Radio Continuum Survey of an Optically Selected Sample of Nearby Seyfert Galaxies.

HOGG, D.E.; ROBERTS, M.S.; BREGMAN, J.N.; HAYNES, M.P. Hot and Cold Gas in Early-Type Spirals: NGC 3623, NGC 2775, and NGC 1291.

HYMAN, S.D.; CALLE, D.; WEILER, K.W.; LACEY, C.K.; VAN DYK, S.D.; SRAMEK, R. Radio Continuum Imaging of the Spiral Galaxy NGC 4258.

JORSTAD, S.G.; MARSCHER, A.P.; MATTOX, J.R.; WEHRLE, A.E.; BLOOM, S.D.; YURCHENKO, A.V. Multi-Epoch VLBA Observations of EGRET-Detected Quasars and BL Lac Objects: Superluminal Motion of Gamma-Ray Bright Blazars.

LANG, C.C.; GOSS, W.M.; MORRIS, M. A VLA H92 alpha Recombination Line Study of the Arched Filament H II Complex Near the Galactic Center.

LANG, C.C.; GOSS, W.M.; RODRIGUEZ, L.F. VLA Detection of the Ionized Stellar Winds Arising from Massive Stars in the Galactic Center Arches Cluster.

LARA, L.; COTTON, W.D.; FERETTI, L.; GIOVANNINI, G.; MARCAIDE, J.M.; MARQUEZ, I.; VENTURI, T. A New Sample of Large Angular Size Radio Galaxies. I. The Radio Data.

LEDLOW, M.J.; OWEN, F.N.; YUN, M.S.; HILL, J.M. A Large-Scale Jet and FR I Radio Source in a Spiral Galaxy: The Host Properties and External Environment.

LISZT, H.; LUCAS, R. Comparative Chemistry of Diffuse Clouds. II. CN, HCN, CH3CN & N2H+

LISZT, H.S. The Spin Temperature of Warm Interstellar H I.

PREPRINTS RECEIVED, JANUARY - MARCH 2001

LOCKMAN, F.J.; MURPHY, E.M. A New Survey of Galactic High-Velocity HI Clouds.

MARLOW, D.R.; RUSIN, D.; NORBURY, M.; JACKSON, N.; BROWNE, I.W.A.; WILKINSON, P.N.; FASSNACHT, C.D.; MYERS, S.T.; KOOPMANS, L.V.E.; BLANDFORD, R.D.; PEARSON, T.J.; READHEAD, A.C.S.; DE BRUYN, A.G. CLASS B0739+366: A New Two-Image Gravitational Lens System.

MASON, B.S.; MYERS, S.T.; READHEAD, A.C.S. A Measurement of H(0) from the Sunyaev-Zeldovich Effect.

MATTHEWS, L.D.; GAO, Y. CO Detections of Edge-On Low Surface Brightness Galaxies.

MATTOX, J.R.; HALLUM, J.C.; MARSCHER, A.P.; JORSTAD, S.; WALTMAN, E.B.; TERASRANTA, H.; ALLER, H.D.; ALLER, M.F. A Gamma-Ray Flare of Quasar CTA 26.

MCLAUGHLIN, M.A.; CORDES, J.M.; DESHPANDE, A.A.; GAENSLER, B.M.; HANKINS, T.H.; KASPI, V.M.; KERN, J.S. Upper Limits on Periodic, Pulsed Radio Emission from the X-ray Point Source in Cassiopeia A.

MILLER, N.A.; OWEN, F.N. The Far-Infrared/Radio Correlation in Nearby Abell Clusters.

MILLER, N.A.; OWEN, F.N. The Radio Galaxy Populations of Nearby Northern Abell Clusters.

MINIER, V.; BOOTH, R.S.; ELLINGSEN, S.P.; CONWAY, J.E.; PESTALOZZI, M. Methanol Masers: Tracers of Outflows?

MINIER, V.; CONWAY, J.E.; BOOTH, R.S. VLBI Observations of 6.7 and 12.2 GHz Methanol Masers Toward High Mass Star-Forming Regions.

MINTER, A.H.; LOCKMAN, F.J.; LANGSTON, G.I.; LOCKMAN, J.A. G28.17+0.05: An Unusual Giant H I Cloud in the Inner Galaxy.

MIODUSZEWSKI, A.J.; RUPEN, M.P.; HJELLMING, R.M.; POOLEY, G.G.; WALTMAN, E.B. A One-Sided, Highly Relativistic Jet from Cygnus X-3.

PANAGIA, N.; WEILER, K.W.; MONTES, M.J.; VAN DYK, S.D.; SRAMEK, R.A.; LACEY, C.K. Radio Properties of Supernovae and GRB Sources.

PESTALOZZI, M.R.; BENZ, A.O.; CONWAY, J.E.; GUDEL, M.; SMITH, K. VLBI Observations of Single Stars: Spatial Resolution and Astrometry.

SCHMITT, H.R.; ANTONUCCI, R.R.J.; ULVESTAD, J.S.; KINNEY, A.L.; CLARKE, C.J.; PRINGLE, J.E. Testing the Unified Model with an Infrared Selected Sample of Seyfert Galaxies.

SHAH, R.Y.; WOOTTEN, A. Deuterated Ammonia in Galactic Protostellar Cores.

TESTI, L.; NATTA, A.; SHEPHERD, D.S.; WILNER, D.J. Constraints on Properties of the Protoplanetary Disks Around UX Ori and CQ Tau.

TURNER, B.E. Deuterated Molecules in Translucent and Dark Clouds.

VANDEN BOUT, P.A. Beyond the Atmosphere - Other Factors in Telescope Site Selection.

WALKER, R.C.; BENSON, J.M.; UNWIN, S.C.; LYSTRUP, M.B.; HUNTER, T.R.; PILBRATT, G.; HARDEE, P.E. The Structure and Motions of the 3C 120 Radio Jet on Scales of 0.6 to 300 Parsecs.

WANG, W.-H.; LO, K.Y.; GAO, Y.; GRUENDL, R.A. Gas Distribution and Starburst Activity in the Widely Separated Interacting Galaxies NGC 6670.

WINN, J.N.; HEWITT, J.N.; PATNAIK, A.R.; SCHECHTER, P.L.; SCHOMMER, R.A.; LOPEZ, S.; MAZA, J.; WACHTER, S. A Nearly Symmetric Double-Image Gravitational Lens.

WISEMAN, J.; WOOTTEN, A.; ZINNECKER, H.; MCCAUGHREAN, M. The Flattened, Rotating Molecular Gas Core of Protostellar Jet HH 212.

YI, J.; BOOTH, R.S.; CONWAY, J.E.; DIAMOND, P.; WINNBERG, A. Simultaneous Observations of the Two SiO Maser Transitions at 7 mm Using the VLBA.

YUN, M.S.; REDDY, N.A.; CONDON, J.J. Radio Properties of Infrared Selected Galaxies in the IRAS 2 Jy Sample.

PREPRINTS RECEIVED, JANUARY - MARCH 2001

ZAVALA, R.T.; TAYLOR, G.B. Time Variable Faraday Rotation Measures of 3C 273 & 3C 279.