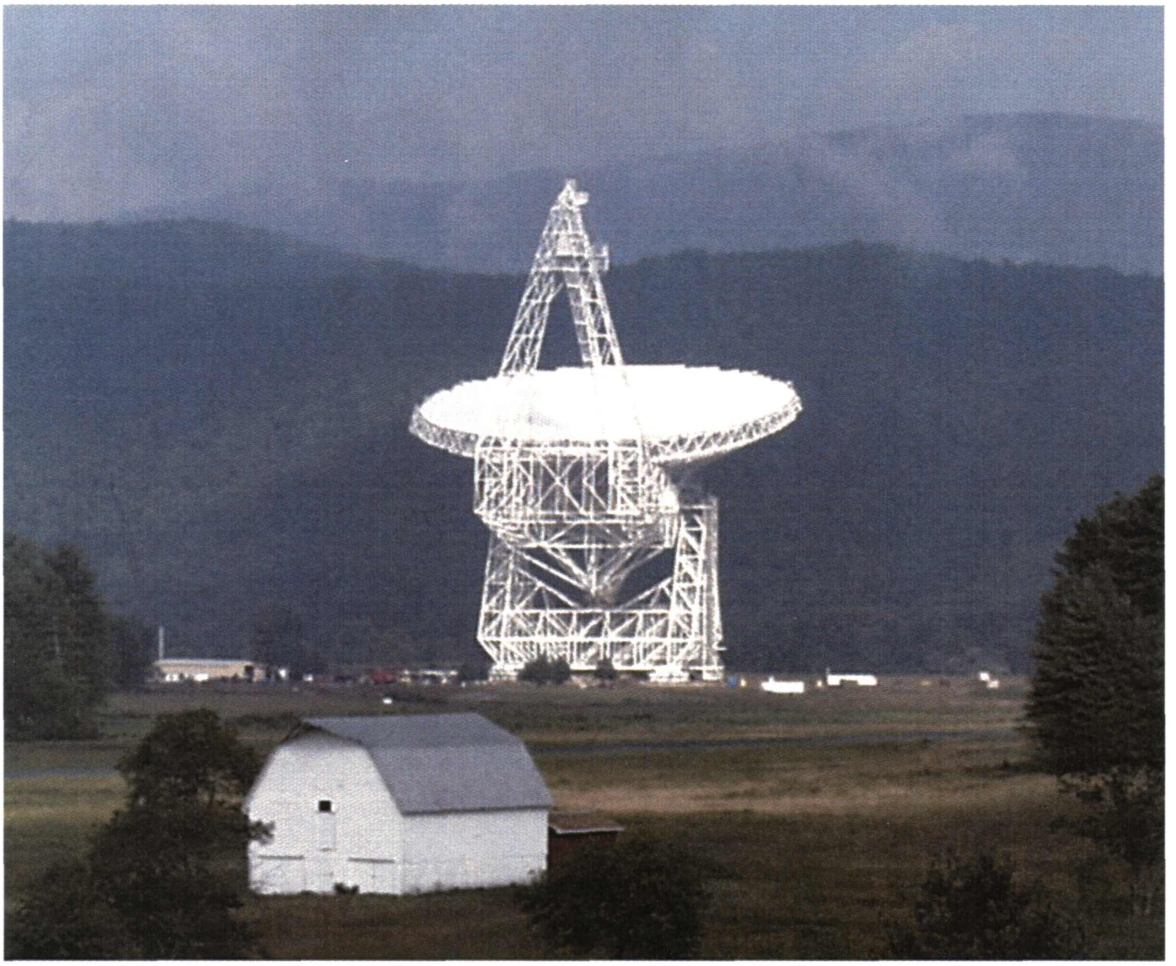

QUARTERLY REPORT

April 1 to June 30, 2000

NATIONAL RADIO ASTRONOMY OBSERVATORY

TABLE OF CONTENTS

A. SCIENCE HIGHLIGHTS

Green Bank

The 140 Foot Telescope has been used to map four square degrees of the galactic plane near longitude 28 degrees in the H I line. These observations, which are the highest angular resolution studies of this region ever done in H I, have revealed a giant H I cloud with an extent of 150 pc and nearly 10^5 solar masses of H I, whose core is cold and in self-absorption but whose outer regions are much warmer and in emission. The core is associated with 1720 OH emission in an anomalous state of excitation. There may be some star formation associated with the cloud. It is possible that this cloud is just now entering a spiral shock and has been caught in the transition between atomic and molecular phases. The distribution of anomalous 1720 MHz OH emission in the Galaxy suggests that there should be about 100 other objects like this which could be detected if observed in H I at sufficiently high angular resolution.

Investigators: A. Minter, F. J. Lockman, G. Langston (NRAO); J. Lockman (U. Minn.).

Tucson

Discovery of Sugar in Space - The prospects for life in the Universe got sweeter with the first discovery of a simple sugar molecule in space. The sugar molecule glycolaldehyde was discovered in a giant cloud of gas and dust near the center of our Galaxy where new stars are forming. The association of the sugar molecule with a star formation region indicates that it is increasingly likely that the chemical precursors to life are formed in such clouds long before planets developed around the stars. Conditions in interstellar clouds may, in some cases, mimic the conditions on the early Earth, so studying the chemistry of interstellar clouds may help scientists understand how bio-molecules formed early in our planet's history. In addition, some scientists have suggested that Earth could have been "seeded" with complex molecules by passing comets, made of material from the interstellar cloud that condensed to form the Solar System.

Glycolaldehyde, an 8-atom molecule composed of carbon, oxygen and hydrogen, can combine with other molecules to form the more-complex sugars Ribose and Glucose. Ribose is a building block of nucleic acids such as RNA and DNA, which carry the genetic code of living organisms. Glucose is the sugar found in fruits. Glycolaldehyde contains exactly the same atoms, though in a different molecular structure, as methyl formate and acetic acid, both of which were detected previously in interstellar clouds. Glycolaldehyde is a simpler molecular cousin to table sugar, the scientists say.

Investigators: J. Hollis (Goddard Space Flight Center), F. Lovas (University of Illinois), and P. Jewell (NRAO).

Socorro

VLA Produces Evidence of Hot "Bubbles" in Accretion Disk at Galactic Center - Analysis of 20 years of VLA data has revealed a periodicity in Sgr A*, the radio source at the center of the Milky Way. The analysis of more than 500 individual VLA observations shows a quasi-periodic variation in Sgr A*'s radio emission approximately every 106 days. A discrete object orbiting the black hole at the Galactic Center with this period would be distant enough from Sgr A* to be detectable with the VLBA. Since no such object has been detected, the investigators conclude that the variation is intrinsic to the accretion disk surrounding the black hole. They believe that the variation is caused by convective bubbles in the disk. Further work is required to model the cause of this phenomenon.

Investigators: J. Zhao (CfA), W. M. Goss and G. Bower (NRAO).

B. MILLIMETER ARRAY PROJECT

The past three months have seen substantial progress in all areas of the ALMA project. This work has been facilitated by the excellent work done by the various joint working groups formed between the U.S. and European

project teams. These working level groups meet frequently via telecon and in face-to-face meetings on a regular basis. Minutes of these meetings, as well as action items, can be found on the ALMA web site http://www.alma.nrao.edu./committees/index.html.

A major milestone was reached during this period by the delivery to the ALMA Advisory Committee (ACC) of the ALMA Construction Cost Estimate document. This detailed bottoms-up costing was developed jointly by the U.S. and European projects. It provides a specific project scope and Phase 2 costs, including contingency, for an ambitious and scientifically provocative program. The project scope includes an array of 64 12-meter antennas, the four high priority receiver bands, provisions for the addition of six additional bands and five configurations with up to 12 km baselines.

Progress in each of the technical areas includes the following:

Antennas

The principal activity for the antenna division this period was preparation for, and participation in, the Preliminary Design Review (PDR) for the antenna, held at the offices of Vertex Antennentechnik in Duisburg, Germany, on June 19-20. A PDR Information Document was received from Vertex on June 9 and questions arising from this document were sent to Vertex on June 16 so that they could be answered at the PDR. Attending the meeting as reviewers were seven members of the ALMA-US project, three members of the ALMA-Europe project and two independent reviewers from the OVRO and BIMA telescopes. The review went well. No major deficiencies in the design concept presented by Vertex were identified. Issues coming out of the PDR were either in the nature of requests for additional design details or analysis to further confirm performance estimates or direction to Vertex to modify some features of the design to improve the operability of the antenna. A formal list of the PDR Issues was sent to Vertex on July 3. After the Vertex PDR, three members of the ALMA-US project attended the ALMA-Europe EIE PDR on June 21-22 in Mestre, Italy.

Another activity during this period was detailed planning and cost estimating for the preparation activities required at the VLA site for the ALMA Test Interferometer. These activities include preparation of the site surface, construction of the antenna foundations, installation of an electrical distribution system which will supply Chilean voltages, construction of a beacon on a tower for near-field holography and provision of control room and office space for ALMA staff.

Receiver

The US-European Joint Receiver Design Group has commenced a series of monthly teleconferences to discuss receiver design issues. At the first such meeting, held April 27, several important design principles were adopted for the ALMA receivers. The most important of these was a decision to exclude Martin-Puplett interferometers from the dewars and adopt the use of balanced mixers with waveguide LO injection for all bands. Considerable work was done on the issue of single vs. double sideband operation.

The masks for the sideband-separating, balanced mixer for the 211-275 GHz have now been completed, and wafer fabrication at UVA will commence in May. The design of the mounting block was continued, and it is anticipated that mounting blocks will be ready when the first wafer is received.

The design of the optics for the Evaluation Receivers has been completed. Work has continued on the cryogenics and the two 4 Kelvin refrigerators based on the CTI 1020 15/70 Kelvin refrigerator head were completed. The compressor unit designed to drive the 4 Kelvin refrigerators is nearing completion with tests scheduled for the month of July.

Work continued on the measurement apparatus for the prototype of the internal IF amplifier for 4-12 GHz to be used with an SIS mixer. This work has concentrated on performance of the isolated amplifier and the measurement apparatus used in the tests, with emphasis on good RF match which will result in accurate calibrations and noise measurements. A new amplifier body was designed which completely separates the mixer bias circuit from the rest of the amplifier. This body was manufactured in the machine shop and construction was begun. The new design will be built first without the mixer bias circuit and measured; then the mixer bias circuit will be added and the tests repeated; finally, the mixer will be attached and tested as an integrated unit. These tests will continue throughout July and possibly into August.

Local Oscillator System

Further work was conducted on the characteristics of the 80 GHz LO driver chain. Work is now aimed at characterizing the phase and amplitude noise contributions of each component. Partially completed work indicates that the contributions of all components following the YIG-tuned oscillator are negligible, which opens the possibility of closing the phase-lock loop at the fundamental frequency of the YTO, which should make the system cheaper to build than in the case of closing the loop at the final output frequency. The test system has been reconfigured to measure the dependence of phase on temperature of the various components. This is important in order to determine the long-term phase drift, as opposed to the short-term phase noise.

The diodes for the 110/220 GHz multiplier have been measured and installed in the multiplier test block. Although the diodes are tuned a little higher in frequency than is desired, skewing output power toward the high end of the tuning range, and the driver power available at 110 GHz is a low 20 mW, efficiency of about 25 percent was achieved. This is sufficient to drive an SIS mixer, a major objective of this effort. New batches of diodes will be required for the 55 to 110 frequency doubler which provides drive power for the 110 to 220 frequency doubler. An alternative is to obtain on loan from JPL a power amplifier capable of covering the required frequency range.

Work continues on the photonic reference system. Hardware is being designed and built for the test interferometer and is on schedule. There has been considerable correspondence with our European partners with regard to the now funded work on high speed photo detectors being undertaken by MPIfR. A memorandum of understanding has been signed between NRAO, Rutherford Appleton Lab and MPIfR involving cooperation between the various parties. A meeting will take place in Bonn in May between the interested parties with the intent of establishing a work plan that will lead to a photonic local oscillator system suitable for the ALMA project.

Work was completed on the phase drift of the components of the prototype LO power driver chain; the performance is satisfactory for ALMA. A draft of the LO Multiplier section of the new ALMA Project Book was written and reviewed and will be submitted soon. A draft memo on the results of the phase noise was written and reviewed and will be issued soon. Planning has begun for an integrated test of the LO driver chain using a photonic reference.

Work was continued on the design of an integrated varistor doubler/power amplifier module to convert 25-30 GHz to 50-60 GHz power. This will be done using custom UVA diodes in the doubler section. Amplifier blocks for a 26-40 GHz power module were completed, but Agilent was unable to deliver the MMIC chips and an alternate source, Hittite, is being investigated.

Measurements of the first of a new series of frequency multipliers were carried out. This frequency doubler is nominally centered at 110 GHz input frequency. Since we do not yet have a power amplifier for this band (one is coming from JPL as part of our collaborative effort), the 110 GHz doubler was severely underdriven, resulting in low output as predicted by the model. Nevertheless, it produced peak power of > 2 mW and produced sufficient power to drive a single-ended SIS mixer (in excess of 200 microwatts) from 204 to 232 GHz. Plans are being formulated to use this LO source with an SIS mixer in order to measure its amplitude noise characteristics.

Correlator

A detailed review of the Long Term Accumulator card was held, resulting in approval of the design. The printed circuit card layout for the LTA has now begun. Programming for the Xilinx FPGA chips for the FIR filter was completed, and printed circuit card layout has begun. Revisions to the station card are in progress. Detailed design of the correlator card continues.

The first tests of the new Xilinx Virtex-E FPGA chips, fabricated in a 0.18 micron process, were conducted using a test program which exercises every circuit in the chip at 125 MHz clock rate. The power dissipated was only 1.8 watts, indicating that the expected power consumption of the correlator has been estimated realistically.

An initial design of the station logic control card was completed. PCB layout will be delayed until later in the year, allowing for changes in the design which may arise.

The preliminary design of the Station Card was completed, and there was a detailed review. Following the review, the design was completed and PCB layout was begun.

A preliminary layout of the bins and racks was completed, along with a preliminary rack floor plan of the entire correlator. It appears that a total of 32 24-inch racks will be required; this is down from an earlier estimate of 48 racks.

Computing

In April, a draft "Implementation Guide" to provide for hardware designers was circulated within the project. The Science Software Requirements committee met and discussed comments they received by email for a review of their initial report (Memo #293). A joint software workers meeting was held in Garching to discuss the status of the software designs, most notably the progress that has been made in the requirements and design of the ALMA Common Software (ACS). The NRAO/ESO technical exchanges continue, with design and implementation of CAN nodes into the ACS.

Clarified the timing specification for CAN devices requiring precise timing. Reactivated software engineering activities (coding standards, documentation formats). Prepared a board revision for the ALMA Monitor and Control (M&C) standard interface. Prepared a document and outlining options and recommendations for interfacing the M&C system to the total power detectors. Attended the Vertex Antenna PDR and revised the Antenna/M&C ICD. Issued an internal draft of an ALMA Common Software architecture document. Obtained a steep discount for the Rational Rose CASE tool. Worked toward standard states and methods of documenting software device controllers. Determined commanding styles for fringe generator and nutator devices. Continued development on use cases and architecture following the Science Software Requirement committee report. Decided where to perform coordinate conversions (at the ABM). Implemented 800 MHz test correlator modes and worked toward fine-delay adjustments and resolving test correlator timing issues (the system clock for the test correlator is not the same as for the baseline correlator). Improved the planning of the control software required for the test interferometer.

System Integration

Several memos have addressed the subject of the relative sensitivity of DSB and SSB front-ends, but each omits some aspect of this surprisingly complicated subject. Made revisions to the MC bus spec and antenna ICD with respect to the CAN reset line. Reviewed the final recommendations from the Systems PDR and Test Interferometer CDR held last month and started to prepare responses.

Started review of new ALMA M/C Implementation Guide. Wrote and distributed a new specification on ALMA timing reference signals, including a decision to change the low-frequency reference from 20.0 to 20.833 Hz; see http://www.tuc.nrao.edu/~ldaddari/timingSignalSpec.txt . Worked with Graham Moorey on various receiver design issues for the test interferometer, including gain flatness requirements, configuration and frequency coverage of Band 3 receiver. and other such details. Began creation of complete parts lists for the Test Interferometer. Finished and submitted to Darrel draft responses to the Systems PDR and Test Interferometer CDR recommendations. Wrote first draft of ALMA documentation standards (intended as a significant expansion and clarification of the present documentation policy).

Conducted a Test Planning meeting to develop detailed plans for the testing of the prototype antennas. The meeting focused on the required tests and analysis to select an antenna design to replicate.

Science, Calibration, and Imaging

Investigation of the pointing analysis problem for ALMA has led to an understanding that our stringent pointing specification will require an accurate measure of the pressure, temperature, and relative humidity at each antenna (for the refraction calculation), thus putting some stringent requirements on these measurement devices. This is being addressed in a memo on pointing.

Meetings of the ASAC were held, as well as the Configuration group, the SSR and the weekly ALMA/US Imaging and Calibration Group. Wrote summary of ALG issues for the ASAC, as well as a response to the JRDG proposed receiver specifications and the SSR queries. Visited A. Harris and others at UMD to familiarize with BIMA developments, and with progress of the water vapor radiometry efforts within the MDC. Also visited the AOC, where the ImCal meeting was held, as well as discussions with Cornwell and others on AIPS++ and ALMA.

Development of a calibration plan continued, the plan to be presented shortly. Continued to investigate the amplitude calibration problem, along with Dick Plambeck of the JRDG. Will shortly present a calibration method which should allow ALMA to approach the 1 percent amplitude calibration specification suggested by the ASAC. Also continued to work on pointing requirements for the ALMA antenna, including further testing of optical pointing on the

NRAO 12 Meter antenna. Also attended the Vertex antenna PDR in Duisburg, Germany, as representative of the Calibration and Imaging Group.

Site activities continued, despite the winter months in Chile. Visited the Chajnantor site to upgrade, repair, and replace equipment. No data exist on the atmospheric structure during the southern hemisphere winter, so six radiosondes were launched, on various days. Owing to a shortage of parts, the ALMA/US interferometer is now running with the ALMA/EU 183 GHz radiometers, with which they are aligned. Attended the Cornell-Texas workshop on a 15 m infrared telescope for the Atacama site. Worked on updating the ALMA atmospheric statistics with new data from Chajnantor, the nutator design, and refined site position information from GPS. Radford completed Memo 312, Refined Position of ALMA Equipment on Chajnantor, and Memo 314, Underground Temperature Fluctuations and Water Drainage at Chajnantor.

Updated the Project Book Chapter 15 and finished a complete design report for the donut/double ring ALMA configuration, as well as produced a WEB page for the simulation image library for the configuration study, complete with the links to the FITS format test images. Conway reports nearing a final design for his zoom array concept, also, and at the configuration meeting this month, the process of simulating observations with the two designs was discussed, the process to begin shortly.

Personnel

At the end of the quarter, 46.5 full-time equivalent staff were assigned to the ALMA Project at the NRAO.

C. GREEN BANK TELESCOPE

Project Summary

The installation of the 2,004 surface panels on the GBT was completed on April 24. The setting of the panel corners was started on April 11 and was completed by May 18. The corner setting was done by COMSAT personnel and NRAO engineers, technicians, and telescope operators. COMSAT completed photogrammetry of the GBT primary reflector surface on June 6. Preliminary photogrammetry results indicate that only a small percentage (about 1%) of the surface actuators needs to be adjusted. The routing of panel gaps is essentially complete.

The first round of tests on the 2,209 actuator cables was completed on April 12. The tests showed that 680 cables failed their insulation resistance test due to wet connectors. The cables with wet connectors were hung out to dry. Preliminary results from the second round of cable testing indicate that all but about 70 of the cables now pass their insulation resistance test.

COMSAT and NRAO-GB completed the GBT Site Closeout Agreement on June 14. As a result of the agreement, the COMSAT warehouse and backup structure walkways will remain after COMSAT leaves the site. In exchange for these items, NRAO agreed to install surface retroreflectors, take a more active role in testing and connecting actuator cables, and forego repairs on the damaged asphalt road.

The NRAO azimuth cable wrap was installed in the pintle bearing room. The optical fiber cable that carries IF and computer signals between the telescope and the electronics room was pulled from the base of the telescope to the receiver room on June 26. (The cable was pulled between the base of the telescope and the electronics room in the Jansky lab some time ago.) The cable was routed through the azimuth cable wrap and the servo room before being taken up the alidade and vertical feed arm. Many of the optical fibers will be separated from the cable and terminated in the servo room.

The antenna Central Control Unit (CCU) was connected to the GBT M&C system on June 14. The connection allows the M&C software to monitor readings from the azimuth and elevation encoders. The encoder readings can be used by the laser metrology system for automatic pointing, as opposed to manual pointing, of the lasers for measurements of targets on the GBT structure.

The calibration of the zero point offsets on the laser rangefinders was completed, and all 12 ground rangefinders with control panels were installed by April 10. The point-to-point measurements using all 12 ground rangefinders were repeated on April 28. Discrepancies identified in the data that were recorded during the experiment are being investigated by the metrology group. A structural model of the telescope was developed so that automatic laser pointing

routines could be written. On May 22, the M&C interface to the metrology system was successfully tested by controlling a laser rangefinder. This achievement is a significant milestone in integrating the metrology system into telescope M&C.

The calibration of the surface retroreflectors that are oriented at 25, 35, and 45 degrees within their mounts was completed by telescope operators before April 6.

The road to the GBT is being rerouted around the GBT site. The new road will help control access to the GBT and will prevent vehicles from interfering with measurements made by the ground laser rangefinders. The road will be covered with gravel initially, and will be paved with asphalt as future funds allow.

The assembly of the four beam, dual polarization Q-band receiver was finished the week of April 3. The receiver was cooled, and laboratory tests indicate that the receiver temperatures in each of its eight channels averages about 40-45 K, in close agreement with what was predicted.

The Green Bank machine shop completed the fabrication of the azimuth track covers, the 340 MHz feed for the prime focus receiver, and the reinforcements to the ladder that provides access to a laser on the telescope feed arm.

Measurements were made of the commercial and conditioned AC power in the new Jansky lab. The quality of the power was suspect because recently purchased UPS units were unexpectedly switching on and off during routine operation. The quality of the AC power does not appear to affect the operation of other equipment in the electronics room. The results of the measurements suggest that the power conditioner and RFI filters in the new lab operate properly. Upon the recommendation of the UPS manufacturer, the UPS units are being replaced with more robust units.

Major components in the RF section of prime focus receiver 2 were assembled to test the ability of a Model 1020 refrigerator to cool the receiver dewar. The test results show that the 1020 will be a suitable refrigerator for the receiver.

The design of the cryogenic compressor packages was enhanced to optimize the separation of lubricating oil. One of the six compressors has been modified to incorporate the new enhancements and is currently being tested. Modifications to the other five packages are underway.

Project Budget
(as of April 30, 2000)

The remaining money to be spent in the Electronics and Monitor and Control budgets is earmarked for an array of computer disks (RAID) and a data access workstation. The remaining money to be spent in the Surface and Pointing budget is for the installation of the laser access platforms on the GBT feed arm, the installation of cardinal point weld plates on the GBT structure, and the wiring of the feed arm lasers.

Category	Allocation ($k)	Expended ($k)	Balance ($k)
Antenna	9	25	(16)
Electronics	30	8	22
Surface/Pointing	74	7	67
Monitor/Control	56	0	56
Project Management	153	52	101
Total	322	92	230

Project Major Milestones

Milestone	Original Date	Revised Date	Completed
Complete Q-band Rx	03-31-00	04-07-00	04-07-00
Complete Q-band tertiary	04-15-00	12-31-00	
Complete IF rack	07-14-99	05-25-00	05-25-00
Complete 290/395 feed	08-16-99	05-31-00	05-31-00
Modify holography Rx	12-01-99	05-15-00	05-15-00
Install ground lasers	06-28-99	04-10-00	04-10-00
Repeat ground laser meas.	06-28-99	04-28-00	04-28-00
Calibrate surface retros.	02-25-00	04-12-00	04-06-00
Measure az. track profile	09-15-99	09-01-00	
Complete commission schd.	02-29-00	05-10-00	05-10-00
Complete act. cable test 1	04-01-00	04-12-00	04-12-00
Complete act. cable test 2	05-31-00	07-14-00	
Complete ACR outfitting	06-01-00	09-30-00	
Complete panel corner set	06-01-00	06-15-00	05-18-00
Install L & S-band feeds	06-15-00	07-24-00	
Measure all Rx feeds	07-03-00	08-14-00	
Assemble all cryo. comp.	07-14-00	09-01-00	
Feed arm servo tests	06-30-00	08-04-00	
Az/El servo tests	08-18-00	09-15-00	
Install NRAO az cable wrap	06-23-00	06-22-00	06-22-00
Install optical fiber cable	07-14-00	06-26-00	06-26-00
Reroute GBT road	06-30-00	07-14-00	
Terminate optical fibers	07-28-00		
Install weather station 2	08-18-00		
Install feedarm lasers	08-14-00		
Install receivers	09-15-00		
Install LO & IF racks	09-30-00		
Antenna acceptance	09-30-00		
Install perimeter fence	11-17-00		

GBT Software

General

The new 85-3 telescope control system is wholly based on "Ygor," the portable part of the GBT M&C software. By the end of June, it had been running very reliably for six weeks or so on this unattended telescope. During this period, there were just two unexplained interruptions in the observations that may be attributable to the software. The extreme reliability of this system gives U.S. some confidence that the control system of the GBT itself will be similarly robust.

We are continuing with our efforts to make the GBT Metrology system more readily available to investigators from other groups. When this effort is complete, a repeat of the successful laser test measurements of June 1999 from a general purpose workstation will be done. We presently plan to be able to make the first observations of this type in July.

Personnel

We are pleased to welcome Richard Prestage from NRAO Tucson, who will now join the software group in July. He will take over the management of GBT software development from Gareth Hunt in September.

Monitor and Control

A major milestone was achieved on June 14, when we were able to perform the first live control of the GBT main axes by the GBT M&C software. Although the contractor cannot let us drive the telescope during construction activities, we are now able to monitor the antenna position, motor currents, and warning conditions continuously.

The software to control the upgraded IF rack and IF router are complete. Except for debugging, we believe that we have all the components available to deal with the multiple IFs of the GBT.

Work is in progress to complete the software control of the LO system, including switching signals to the front-ends and back-ends. The software is almost complete, and should be available for extensive tests in July.

The GBT integration tests exposed limitations with the computers used to support the ongoing observations. In particular, we are becoming limited in CPU speed and memory. Fortunately in a distributed system such as M&C, the tasks can be run on any computer. We therefore made a major effort to enable all M&C software, especially the CPU- and memory-intensive tasks, to run on commodity PC hardware using Linux. Most of the major changes to enable M&C to run on a non-network-order ("Little Endian") computer have been done over the last two years. However, now the last remaining changes are almost complete. Most of the permanently running programs ("daemons") of the M&C system are now executing on a Linux PC.

Telescope Operations

GBT Operations Documentation

Final draft of the GBT Metrology System Operations Description document was completed in the second quarter. The evaluation of the commercial tool for use of maintaining the operations manual in both hard copy and on the Web was also completed. This tool is Robohelp. A preliminary version of the manual is now available in hard copy format and is available from the GBT Telescope Operations Web page. Documentation and development of specific outfitting procedures for maintenance pre-brief, visitor pre-brief, outfitting schedule conflicts and general site access requirements will be completed toward the end of the third quarter.

Operations extensive review of the Comsat documentation was completed in the second quarter. Also completed were negotiation of the remaining controversial issues of their documentation plans. Once the final version of the Comsat documentation is supplied effort will begin on incorporating it into the GBT operations system. This should begin in the third quarter.

GBT Preventative Maintenance

A realistic estimate of the preventative maintenance manpower and telescope downtime was completed in the second quarter. The list of required lubrications and their cost estimates was also completed. A preliminary list of special tools and heavy equipment needed for GBT maintenance will be completed in the third quarter. A more detailed

plan for the maintenance use of the Comsat warehouse will also be completed in the third quarter. Effort on developing an inspection plan was started in the second quarter and updating the GBT spares lists continues. These efforts will continue on into the third quarter.

GBT Operator Training

Because of heavy commitment of the Operations group to the outfitting effort in the second quarter Operator familiarization training on the Comsat control devices for the GBT, HVAC, and Cryo sub systems were not completed in the second quarter. These will be completed in the third quarter. A comprehensive review of the training program will also be started in the third quarter.

GB Maintenance Book Keeping

The original plan for "piggy backing" the NRAO NM Mainsaver server was changed after a current re-investigation of costs revealed that it would be cheaper to purchase the software and hardware for GB. The Mainsaver plans were changed and the Mainsaver software and the hardware for the server were purchased during the second quarter. A detailed plan for implementation will be started in the third quarter.

GBT Operations Outfitting Contribution

In the second quarter the GBT Operations personnel continued assisting in GBT corner setting effort, actuator cable testing and assisted in the installation of the GBT azimuth cable wrap, the installation of the fiber optics cable, supported tests of GBT receivers and have become involved in some of Comsat's problem areas. This effort (especially installation of surface retro reflectors) will continue in the third quarter to such an extent that majority of the GBT Operator pool may be tied up in these tasks.

Use and Testing of the GBT M&C Software System

Whenever possible and practical GBT operators have assisted and become involved with testing and use of the M&C software system. Involvement in testing of the user interface increased in the second quarter. Further involvement will increase as the system becomes more usable during the third quarter.

Move of the control of GBI and 85-3 to the Jansky Lab Control Room

Moving the control of 85-3 to the Jansky Lab was completed in the second quarter. The control of this system uses the basic GBT M&C software system and user interface. All of the hardware changes and some of the software implementation for moving the GBI control to the Jansky Lab were also completed during the second quarter. The GBI control software will be completed during the third quarter. Operations is gaining real experience controlling telescope systems using the GBT M&C software system and will continue to gain significantly more experience before NRAO receives the GBT.

D. CENTRAL DEVELOPMENT LABORATORY

Amplifier Design and Development

The performance characteristics of the 3-13 and 8-18 GHz InP amplifiers developed in the previous quarter were fully determined and the designs were released to production. Work will commence soon on designs extending the lower end of the InP amplifier series down to 1 GHz.

A collaboration with S. Weinreb at JPL was begun, with the objective of evaluating the suitability of MMIC low-noise amplifier chips to NRAO requirements. To that end, sample chips have been obtained from JPL and their packaging will be explored. Their performance will be compared to that of the existing MIC designs employing chip-and-wire construction techniques.

Amplifier Production

A total of 22 amplifiers was completed during this quarter. Production included: four C-band, two K-band, two K_a-band, six Q-band, four W-band, and four 8-18 GHz amplifiers. The W-band and 8-18 GHz amplifiers will be used by Socorro for VLBA receiver construction with the other units being supplied to various end users.

The amplifier group has continued to support the ALMA project with manpower and construction assistance in the SIS-integrated amplifier development effort, and with additional technical support to ALMA in the construction of bias power supplies and the use of cryogenic test fixtures.

Superconducting (SIS) Millimeter-Wave Mixer Development

SIS Mixer Development

After a delay due to a software problem in the E-beam lithography system, the new 602-720 GHz mixer is now being fabricated at SUNY/Stony Brook. The junction level has been completed. If all goes well, we should receive the first devices for testing by the end of July. The mixer blocks with integrated scalar feed horns are being made by Custom Microwave, Inc. This single-ended mixer will serve as a building block for balanced and sideband-separating mixers for ALMA. The existing 200-300 GHz Infrared Lab test dewar has been modified and will be used to test the 602-720 GHz SIS mixers.

The 211-275 GHz single-chip balanced sideband separating mixer for ALMA is being fabricated at UVA. During this quarter, the mixer block was designed; it differs from previous NRAO SIS mixer blocks in that it contains bias circuits for the four component mixers. A miniature commercial connector, rated for operation at 4 K and space-qualified by NASA for use on SIRTF, has been selected as the bias connector for this mixer.

We completed the initial design of a broadband matched waveguide power splitter. It is a folded magic-T with a terminated coaxial fourth port, made as a simple split block. It should be scalable to ~700 GHz. This is an important component in sideband-separating mixers made in waveguide (as opposed to the single-chip designs developed at NRAO). A WR-10 version will be tested shortly.

SIS Mixer Testing

In this quarter, we began upgrading the existing measurement software to use a server-based database engine. Server-based databases increase database access speed and also allow significantly larger data files than are available with the present Microsoft Access based system. The database structure was also changed to minimize redundant measurement records. The user interface is undergoing upgrades to simplify listing and sorting of existing mixer measurements, and to improve configuring the eight different parameters that can be changed during a measurement. These software upgrades will be completed in the third quarter. During the third quarter, the capability to measure and plot mixer noise temperatures as a function of bias voltage, magnetic field, and IF frequency will be added.

The dewar wiring was upgraded to support the four mixers used in balanced sideband-separating mixers. Construction and checkout of the last two IF preamplifier bias supplies were completed during this quarter.

Broadband IF Development

Work continued on the development of the 4-12 GHz IF preamplifier. The first preamplifier, a modified amplifier of successful design by M. Pospieszalski, had problems believed to be caused by feedback through the mixer bias circuit. The amplifier body was redesigned to accommodate the mixer bias circuit and isolate it from the rest of the amplifier. The amplifier body has just been completed in the shop, and the complete preamplifier with mixer bias circuits will be tested in the next few weeks.

The other major effort this quarter has been the 4 K amplifier measurement system. We have been successful in fully automating this system with the help of John Effland. However, we are finding some problems in the measurement system. We are working to resolve differences between amplifier measurements made using this test set with those made using the amplifier group's 15 K measurement system, which appear to be caused by one or more mismatches in the 4 K dewar between the noise injection coupler, variable temperature load, and the amplifier.

Publications

A. R. Kerr, S.-K. Pan, A. W. Lichtenberger, N. Horner, J. E. Effland, and K. Crady, "A Single-Chip Balanced SIS Mixer for 200-300 GHz," *Proc. of the 11th Int. Symp. on Space Terahertz Tech.*, Ann Arbor, May 1-3, 2000. Available as ALMA Memo No. 308 at http://www.alma.nrao.edu/memos/html-memos/alma308/memo308.pdf

D. Koller, G. A. Ediss, and A. R. Kerr, "Dielectric Constant of Gore-Tex RA7956/7957 Radome Material in the Frequency Range 1 MHz-2 THz," ALMA Memo No. 309, May 25, 2000. Available at http://www.alma.nrao.edu/memos/html-memos/alma308/memo308.pdf

Electromagnetic Support

GBT

Measurements were completed on the S-band (1.70-2.60 GHz) feed. The patterns are symmetric in the two principal planes. The pattern level varies between -13.8 dB and -15.4 dB at 15 degrees off boresight in the frequency band of 1.70-2.60 GHz. The worst cross-polarization level is -25 dB. Return loss is better than -28 dB.

Design of the 290-395 MHz Short Backfire Antenna feed was done.

General

A third version of a feed for the 600-720 GHz test receiver was designed. This feed has lower corrugation depth to width ratio for effective electroforming.

Design of a full waveguide band (75-110 GHz) quadrature hybrid branch coupler for use with the balanced mixer was started.

Spectrometers/Correlators

During this quarter, most of the time was spent working on the design of the ALMA correlator with only a small amount of time spent in support of the GBT and Tucson spectrometers.

Support for writing software for the ALMA test correlator (GBT clone) was another minor element of time allocation during the quarter.

Design work on six logic cards accounted for most of the time during the quarter:

1. The ALMA FIR filter card progressed to the point of completion of the printed circuit board (PCB) layout and the procurement of bids for card manufacturing. An internal design review of the card design and of the Field Programmable Gate Array (FPGA) designs on the filter was done.
2. The ALMA Correlator Long-Term Accumulator (LTA) card design was completed and PCB layout begun. An internal design review of this card was performed.
3. Design of the correlator card for the ALMA correlator progressed along with its several FPGA designs. Final completion of this card will be delayed to fit the correlator chip design schedule.
4. The ALMA correlator station card and its three FPGA designs were complete to the point of an internal design review and near completion of a PCB layout.
5. Design of a test fixture card to be used to test the filter and station cards was started. Design of this card was completed to the point of doing trial PCB layouts.
6. Design of the station bin control card was completed to the point of doing trial PCB layouts.

Now that the location of the ALMA filter card has been decided, some work was done on the station and correlator rack layouts. It looks as if the 64-antenna ALMA correlator will require 32 racks, not counting the real-time computer system.

A vendor began a detailed circuit design of the ALMA correlator chip during this quarter.

Accomplishments of the correlator group during the last quarter include:

1. Completion of much of the detailed design work required for the ALMA correlator principal logic cards, along with a number of FPGA designs.
2. Generation of software for the ALMA test correlator to the point of obtaining auto- and cross-spectra in all of its wideband modes.

Goals for the next quarter include:

1. Provide engineering support for the initial operation of the GBT and the GBT spectrometer.
2. Complete assembly of filter card, LTA, station card, and station logic test fixture card.
3. Start building the test fixture for filter and station cards.
4. Start writing software for LTA, station control card, and test fixture card microprocessors.
5. Continue support of the ALMA correlator chip design.

ALMA LO Source

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

Much time was spent this quarter composing the LO Section of the ALMA Project Book. Also, two ALMA Technical Memoranda related to LO development were written. The technical goals and specifications for the LO system were also developed.

Work this quarter was also concentrated on the phase drift issue related to the LO source chain. Preliminary data reveal that the drifts in LO sources on this time scale tend to be linear. Therefore, phase drifts of the electronics on shorter time scales can be effectively estimated from the 10-minute data. The ALMA goal for phase drift of 2.4 degrees at 950 GHz can be achieved using this technique.

Work continues on the development of integrated amplifier/multiplier components for use inside the phase-locked source. Various pieces of the circuitry were fabricated this quarter.

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.

During this quarter, the 110/220 GHz doubler was fabricated and its performance evaluated. Measurements confirm that the output power from the doubler is suitable for pumping an SIS mixer operating in this band in accordance with the ALMA specification. Work continues on the development of this multiplier to increase the output power to a level suitable for driving higher frequency multipliers.

In collaboration with the UVA group, we are developing capacitors that are suitable for integration with GaAs circuit processing. We are encouraged by the working properties of Chemical Vapor Deposition-grown oxide for use as the dielectric. Test structures have been fabricated with the correct capacitance per unit area needed for the 81/243 GHz tripler circuit. An RF test circuit with integrated capacitor was fabricated this quarter and will be evaluated at 100 GHz early next quarter to verify the electrical model.

The design of the 81/243 GHz tripler continues to evolve, taking into consideration refinements to the diode and capacitor fabrication processes. A final version of the design will be completed early next quarter with wafer processing to commence shortly thereafter.

Also in collaboration with the UVA group, we have successfully molded a polyurethane (PUR) replica of the 55/110 GHz doubler. The poor adhesion of the metal to the plastic in the deep narrow channels of the waveguide circuits continues to be a problem that we are aggressively addressing. After many experiments this quarter with electroless nickel plating of the plastic, it was found to be inadequate due to the extremely poor adhesion that could not be corrected. Sputtering continues to be the most promising approach. Experiments involving several different sputtering techniques are planned for the next quarter.

We have completed the fabrication of the 80 K cryostat for cooling the frequency multipliers. The cryostat is currently being characterized.

Fully-Sampled, Focal Plane Array Feed

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

During this quarter, we performed detailed analysis of the low-noise sampling element configuration in order to understand why the measured noise temperature was higher than expected. It was determined that the planar sinuous antenna, which is currently being used as the electromagnetic element, was showing excessive variation in feed point impedance due to the abrupt termination of the metal pattern at the outer edge of the antenna. Several new sinuous element patterns were designed and fabricated this quarter. Plans are in place to measure the antenna impedance of these new designs.

Advanced Radio Frequency Interference Canceling System

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

During this quarter, we continued to make improvements to the current hardware-based, proof-of-concept system. The A/D converter boards have been improved to reduce unwanted noise pickup. A problem with the system clock was identified and corrected. A series of laboratory measurements using this system is being planned for next quarter to explore adaptive filter coefficient stability, attenuation versus interference-to-noise ratio, injected noise spectral properties, and broadband noise cancellation.

Work continues on the development of a fast, clean analog-to-digital converter. The converter, which consists of two complex sampling channels (80 MS/sec each), will be built on a specially designed circuit board with attention paid to proper component layout to reduce unwanted noise. The board design was completed and fabrication will commence early next quarter.

The NSF MRI proposal for the development of a complete adaptive RFI canceling instrument for the GBT was funded, and task planning will begin shortly. In collaboration with a group at BYU, we are also planning to develop an interference excision system for rapidly moving sources of RFI, *e.g.*, LEO satellites. This NSF proposal was also funded.

Meetings

Members of the CDL attended the following meetings this quarter:

11th International Symposium on Space Terahertz Technology, Ann Arbor, May 1-3, 2000 (Kerr, Ediss).

FIRST H IFI Mixer Peer Review, JPL, June 5, 2000 (Kerr).

FIRST H IFI Local Oscillator Peer Review, JPL, June 6, 2000 (Bradley).

IEEE MTT-S Int. Microwave Symposium, Boston, MA, June 11-16, 2000 (Bryerton, Pan, Pospieszalski, Thacker).

MIKON-2000 Conference, Wroclaw, Poland, May 22-24, 2000 (Pospieszalski).

AP2000, Davos, Switzerland, April 9-14, 2000 (Srikanth).

E. GREEN BANK ELECTRONICS

GBT Spectrometer

Firmware and software programming and programming support will continue into the next two quarters. Pulsar features have not been addressed yet, and will probably take longer than two quarters to finish up.

There is a loss in serial communication between the computer and the system monitor card when the system power is enabled. We have not solved this problem to date, and will address it next quarter as time allows. This should not affect operation of the spectrometer, it is merely a nuisance.

The 1600 MHz samplers have been calibrated this quarter.

A large amount of time was spent debugging the hardware. Long Term Accumulator board #3 has failed . We believe this is due to poor pin contact on one of three IC's.

The sample distributor cards still do not work with the improved decoupling scheme. Work continues on this problem.

Enhancements to the system to allow better isolation of faults and integration of software have been designed. One such modification will equip all LTAs with LEDs to indicate the status of various key bits on the cards. Another modification will buffer key signals on the VME interface board and bring them out to front panel test points for easy access with a logic analyzer or scope. These modifications are in process at this time, and should be finished by July 30, 2000.

Other GBT Backends

The Spectral Processor is being used this quarter for debugging and RFI measurements. Measurements on the characteristics of the GBT RF systems are underway.

The Digital Continuum Receiver has been in regular use in the GBT Mockup to test receivers and other equipment for gain stability, temperature stability, etc. It is ready for general use.

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

The GBT VBLA terminal remains to be integrated into the system. It has been hooked up to the IF spigots, and the network and timing signals were installed in preparation for software integration efforts. The computer systems have been started up for the first time since being moved from the 140 Foot Telescope.

GBT Fiber IF System

The IF Rack was finished this quarter. It is undergoing tests in the GBT Mockup with the remainder of the IF system. This will continue until we break down the mockup to move the racks to the telescope.

GBT Servo System

The servo monitor system has been installed in the GBT alidade servo room. Preliminary Az-El servo tests are continuing, with NRAO providing engineering help to debug the systems.

A meeting is held regularly between NRAO, Comsat and RSi/PCD to address the current Servo issues.

GBT Receivers

The GBT Gregorian receivers are all complete, with the exception of the Q-Band receiver. All the receivers have been refurbished and are being tested to await installation in the GBT. This process is nearly complete. A change is being made in the cal signals. This modification has been completed on most receivers, and will be completed this quarter. Receivers are being refurbished and tested to await installation in the GBT. This process is nearly complete.

GBT Active Surface

The Active Surface software is in good shape. Some work remains in the interface between the Active Surface and the Metrology systems to allow calibration of the actuator using rangefinder data.

The major activity underway this quarter is testing and connecting the actuator cables. The NRAO is supplying six people to assist the contractor in the cable testing. The first round of testing ended with some 650 cables failing the test due to water in the cables or backshells. NRAO has taken responsibility for testing the remaining cables as time goes on to see if they dry out. Active drying steps are being take for those cables that do not dry out on their own.

Once the cables are all tested, the active surface room can be outfitted. This will be a several month long process.

Q-Band Receiver

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

GBT Cryogenics

Work the past quarter resulted in all tubing runs being completed with the exception of the area at the base of the vertical feed arm, and the connections to the receiver room. The base of the feed arm is being addressed now, and once the receiver room alignment is completed and the room is permanently anchored, the connections into the room can be made.

The tubing runs from the compressor room to the elevation bearing have been leak-checked, evacuated, and pressurized with nitrogen.

Compressor construction has begun, and will continue for the next quarter.

GBT Outfitting

The outfitting of the antenna is beginning to take shape. The cables for the networks, telephone, intercoms, and other NRAO systems are in hand, and ready for installation at our first opportunity. Detailed plans have been made for these installation jobs.

Junction boxes for fiber, telephone, and laser system cables have been fabricated and installed on the telescope.

The main fiber-optic cable run from the Jansky Lab control room to the receiver room has been completed. Termination of the fibers in the servo room will occur next, followed by terminations in the Jansky Lab and the receiver room.

Outfitting the receiver room, the active surface room, and the servo room will wait for COMSAT to vacate the rooms.

OVLBI

This quarter we completed a number of repairs to the OVLBI tracking station.

A problem with cooling the vertex rack was studied, and partial solutions were found. The Peltier heater/cooler assemblies were found to be operating at a substantially reduced efficiency. Spare modules from the GB stock were installed on the station. An additional 2 modules were installed on the system. A controller with more output current capability is being integrated.

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.

20 Meter

Normal maintenance issues have been taken care of. The Mark IV upgrade kit was installed in the USNO recording system. The 20 Meter took its last USNO observation on June 30.

85-3 and the GB Interferometer

The control system on the Interferometer and 85-3 has been upgraded to use the GBT YGOR control system. This system shares a common software architecture and hardware platform with the GBT. 85-3 has been running this software for several weeks. The interferometer upgrade is just now being completed, and no running experience has been gained at this time.

The digital delay rack was tested and found to have many problems. The digital delay cards were all repaired and tested. The sampler cards will be tested and repaired when the system is operational once again.

In addition to these upgrades, normal maintenance and repair was provided. Studies were completed to make the focus/rotation mounts usable again. This upgrade of the focus/rotation mounts is awaiting funding

General Site Support

The fire alarm system was repaired. Work was done on the site radio communications system that meets the NRQZ limits was installed and tested for Operations use. Support for the 40 ft. educational instrument was provided.

F. SOCORRO ELECTRONICS

Preventive Maintenance Program

Some significant or at least illustrative maintenance activities are listed below:

Hydrogen Maser #11 was returned to the vendor for repair, but the cost estimate recently doubled from $50k to $100k. Compounding the problem, Maser #4 failed. Maser #4 was repaired at the factory six months ago. A contingent from NRAO will visit the factory in July to review maser repair, procurement, and cost. Further maser updates are curtailed indefinitely, though the IF degradation at three VLBA sites indicates the need for maser service by Q1 2001.

Parts have been ordered to rebuild the Atmospheric Phase Interferometer (API) for reliability. Although the engineer for the project left, the plan is to rebuild the instrument in 2000. The API provides real-time phase measurements to the NRAO Web site.

Construction of a new VLA correlator controller is complete and the equipment is being tested on-line. A complete spare VLA array processor now is available because a missing configuration jumper was discovered on another module.

A failure in the IF B Delay/Recirculator system of the VLA correlator seen during the fall quarter recurred and was successfully repaired along with another obscure connection problem. It is conjectured that power failures have "shaken out" the problems.

A review of sample heads for the magnetic tape drives at the factory revealed that a "ghost" gap can be formed by cracks in the head material or by flawed mounting of the head to the substrate. Such faulty gaps cause bad bit error rates. The study is a step in understanding and responding more efficiently to head wear. Plans to obtain a profilometer mentioned in an earlier report have been set aside in view of budgetary constraints.

Tape offsets as a function of tape speed have been installed and tape path calibrations are being checked.

Alternate brushes are being installed on VLBA drive motors as wear symptoms appear. As well, improved filters have been installed. The expectation is that drive motor failures will be reduced.

Solar calibration software has been transferred from an unreliable and obsolete HP85 to a laptop, which should help speed up calibrations. The calibrations are about 25 percent complete. Delivery of an amplifier for installation of solar calibration on a Q band receiver is now delayed until August.

Continued power failures at the VLA have brought attention to the need to clarify and enhance alarm indications provided by the so-called "wyecom" alarm system. Improvements will be scheduled in Q3 after a thorough audit of the alarm system and accompanying procedures.

Notifications by USAF and others of special use of certain frequencies continue. An effort was initiated this quarter to develop a system that will permit routine notification to observers of the potential RFI.

Projects

VLBA PT Link

The essential goal for 2000 is to provide the link to VLBAPT for observing at high resolution during the VLA A configuration in October 2000. To meet the goal, two M32 spares have been constructed and checked out, and a work-around found for the "loss-of-sync" problem with the L8 timing module. A problem has been identified with correlating invalid data introduced because of the increased time delays. Implementation of a work-around is planned for Q3.

New Receivers

An essential goal is to assemble and install an additional six Q-band receivers and four low noise K-band receivers on the VLA in 2000. Two Q-band receivers and one K-band receiver were installed this quarter.

Three W-band receivers were available at Fort Davis, Pie Town, and Los Alamos for the CMVA run this quarter. An additional W-band receiver is scheduled for construction in time for a CMVA run in October. Also, Receiver #3 is scheduled for rebuild to accommodate MAP amplifiers in time for the October CMVA run. The rebuilt #3 will lack the wider bandwidth performance of the new W-band receiver design. A second iteration of the new "Y" coupler design seems to have successfully addressed insertion loss problems with the first design.

Upgrade for the Pulsar High Time Resolution Processor (HTRP)

A NM Tech project, the HTRP upgrade has been supported by NRAO in part. Release of the 200 MHz FADC for construction awaits successful checkout of the prototype. Rework of the VME timing card is planned for completion by Q4.

VLA Expansion Project (EVLA)

The Electronics Division goal for the EVLA project is to produce a functional block diagram in 2000. An RFI test plan has been prepared to test emissions from electronics modules as they become available, a key element in deciding if sampling can be conducted at the antennas. An anechoic chamber that can be used for tests has been located at NMSU in Las Cruces. Environmental monitoring at the VLA is scheduled to commence in Q3.

A thorough inventory of monitor and control points for scientific, operational, and technical needs has been prepared. Identification of a "field bus" at the antenna and a specification for the transition from old to new antennas will be addressed during Q3 and Q4. Also, a specification for the LO will be prepared.

Initial tests of a two-port serial line controller (SLC) hardware show the need to correct "hand shake" and "signal transmission" problems. The SLC will be used for developing on-line control software. Initial tests are important goals for this quarter.

Another important goal in 2000 is to extend the existing 200 MHz VLA IF to 300 MHz by means of wider front-end filters. Fifteen VLA antennas have been modified so far and the schedule advanced so that all antennas can be completed in 2000.

K-Band Water Vapor Radiometer (WVR)

Scientific tests of the two 3-channel WVRs installed last quarter show the need for another factor of 10 improvement in noise performance. Improvements to the design that may permit the better performance have been identified, so that the goal remains to have two WVRs that meet requirements in 2000, even though the engineer for the project left NRAO.

VLBA Panel Adjustments

The VLBA main reflector panels must be adjusted and the subreflector surfaces corrected to achieve the best possible efficiency at W-band. A plan has been developed to use a small (30" - 40") reference reflector antenna mounted on the main dish for phase-referenced holography using a beacon from a geostationary earth satellite. Parts have been procured and a schedule developed to test the scheme in Q3. Software for the back-end analysis computer is prepared.

High Density Recording Rates

To improve the SNR of faint objects, formatter expansions at the Los Alamos, Pie Town, Kitt Peak, and Owens Valley VLBA sites have permitted successful testing of a 512 Mbps recording rate by using two tape recorders simultaneously. The modules to modify three additional sites in Q3 have been checked out and installation scheduled.

VLBA Correlator

An obsolete Sun 3 computer (CCC) used for diagnostics on the VLBA correlator has been replaced with a PC running Linux. As well, a multi-serial I/O system for the new diagnostic computer (CCC replacement) has replaced terminal emulators with diagnostics available on the network.

Engineering ServicesMachine Shop

Components for the new K- and Q-band receivers were fabricated in the Machine Shop. The Machine Shop also fabricated Mod K-band couplers, DB-9 connector box divider, repaired the spare VLBA armature, W-band Cal-coupler, W-band cold plates and waveguide, pipe roller assembly, machine port in 350 cold head, and W-band x2 amp cold plate and waveguide. The Machine Shop also was used extensively for emergency repairs of equipment and tools used on the site. A retirement plaque for Alison Patrick was machined.

Drafting

Drafting continues working with ongoing projects such as updating site utility drawings, Raster to Vector conversions and providing engineering drawing support as required. Additionally a "manual drawing" file list is being placed on a computer database. Provided support on various printing and design projects for the VLA 20th Anniversary Celebration (such as designing PRA T-shirt) and employee good-bye photo posters. Several miscellaneous projects were undertaken, such as Visitor Center backlit display repair, display rework, recorded location of casement BE-7, HP plotter problem fix, and monitor problem fix. The Drafting Group completed a 3D view of the STS/RFI tower area. More current drawings were placed on a web page.

Engineering

The Engineering Group completed their research into alternative materials for building dichroic panels. Material may be ordered pending funds at the end of the third quarter. An optical telescope was specified and ordered. This telescope will be used to identify antenna pointing problems. A summer student has been recruited and assigned the optical telescope project to measure antenna-pointing efficiency and to assist in pinpointing causes for errors. The telescope system will be assembled and implemented by a summer student during the next quarter.

Another summer student was recruited to work on an antenna ray tracing program that will be used for VLBA holography and subreflector measurement.

The L-band cover fabrication is completed. The Pie Town VLBA receiver has received an oil cleaner sample for gearboxes in an effort to keep gearbox sight glasses clean. Periodic checks will occur this year to monitor its effectiveness.

The preliminary layout for EVLA fiber optic cables has been presented to the EVLA committee and a budgetary estimate for the ALMA prototype site work has been submitted. A Geotest core drill for a third ALMA antenna foundation was made. Preliminary plans for the ALMA VLA site work is complete and work on the site should commence in the next quarter.

Modifications were made to AOC basement HVAC unit #31. Two rooms were inspected and several controllers were adjusted to mitigate the problems with the AOC HVAC systems.

A prototype grab bar for accessing the VLA dishes was installed on Antenna 1 for testing. Minor modifications were made and one is being installed on Antenna 11 for further testing. Installations will begin as soon as the grab bar is approved.

Miscellaneous work accomplished includes: working on design for repairing control building stairs; St. Croix painting; and, a servo brush shaping device gearbox was built.

We met with SEC to discuss new rates. A new rate change should become effective beginning July 1. A savings of approximately 15 percent on the cost of electricity should begin. We made a request to use these savings for the Energy Conservation Plan that was developed last quarter. A Fall Arrest presentation was made at the ASSE conference by Jim Ruff.

Administrative

The 10-hour schedule was started at the VLA. Several employees completed training in Heavy Equipment Operation and PC Computer training classes. Personnel Evaluation Process (PEP) interviews were concluded. Annual Salary Reviews were completed and submitted. The Personnel Action Notices (PANs) were checked and issued. Monthly staff coordination and project meetings were conducted, with division heads, supervisors and engineers to plan, schedule and review ongoing work efforts. Fire Brigade members received Fire Inspection Techniques training at the Fire Academy in Socorro. Much planning and preparation was made for the VLA 20th Anniversary celebrations held on May 24. Prepared ES Division budgetary, attendance, monthly, quarterly, safety, User Committee, and BAAS reports.

Performed a VLA site power recovery drill. Several action items were submitted and are being corrected. Efforts are being made to eliminate possible single point failures that will cause data loss are being made. Improved plans for communications during emergency callout were formulated. Preventive Maintenance procedures continue to be entered into the Mainsaver maintenance database.

One new antenna mechanic (Frank Broaddus), one track crew laborer (Joe Sanchez) and four temporary employees for the Antenna Mechanics and Paint Crew were hired.

Scheduling/safety

Sixteen accidents/incidents were recorded to date. Ten accidents occurred in the ES Division. Scheduling for upcoming safety training was conducted. Continued monitoring site work areas for hazards and unsafe conditions took place. Safety orientation/training was provided for all temporary employees. Safety incidents were reported, investigated and remedied. Safety priorities were reviewed with new company Safety Manager. Safety awareness sessions on First Aid, Electrical Safety, and Material Handling were conducted.

Weekly coordination of antenna overhauls with supervisors took place with evaluation of work constraints and coordination issues. Developed North Liberty and Kitt Peak Tiger Team task schedule. The D-array reconfiguration schedule was developed and a plan to install a temperature monitor on the VLA antenna condenser was made. A proposal for implementation of Behavior Based Safety is being considered.

Operations and Maintenance

The Array reconfiguration to DnC-array has been completed along with the overhaul of Antenna 1. The Antenna 11 overhaul is 75 percent complete. During the overhauls, we retrofitted the access platforms to pedestal room a/c unit; installed EL hardstops; modified EL encoder mount and added weather enclosure; relocated AZ limit switches; installed feedcone segments and new receiver mounts; and, enlarged holes on transporter lift pads. Elevation cable wrap modifications to improve disconnection of power and control cabling at the elevation axis were installed. VLA encoders were disassembled and rebuilt replacing worn parts, then bench tested to ensure they meet the original specifications.

A successful Tiger Team visit to North Liberty was made in April. Installation of VLBA apex handrail, elevation hardstops, rotation of AZ bearings and several other maintenance tasks were completed. In addition, preparations such as handrails, disassembling and rebuilding drive motors, and EL platform extensions for the Fort Davis and Kitt Peak Tiger Team visits have been made. Fabrication of the prototype Lexan snow covers for VLBA subreflectors were completed. A trip to Hancock was made for alignment of the ellipsoid. The S-X on Hancock VLBA is working very well now.

Antenna Mechanics

The azimuth wheel assembly from St. Croix was broken down and overhauled, and a complete VLBA spare wheel assembly was built.

Antenna painting and water blasting equipment was overhauled and Antenna 3 painting was completed. Antenna 17 is currently being water blasted.

An overhaul was conducted on Antenna 1 while it was in for the gearbox repair. Welds were inspected on all of the VLA azimuth gearboxes; no cracked welds were found.

A K-band receiver was installed on Antenna 1, and Q-band receivers were installed on Antennas 26 and 21. Dish panels were readjusted on Antennas 10, 24, and 28 after holography.

The post reconfiguration transporter maintenance was completed. One hydraulic flow meter was built in-house, which will be used to troubleshoot the transporter limp system. Overhaul was performed on Truck 3 on Transporter 1. The circulating pump on Transporter 1 was resealed. The 5-ton overhead crane was serviced and inspected. The transporter crew assisted in troubleshooting the new track tamper hydraulics.

A handrail rolling mill was built to form a round handrail. VLA and VLBA Apex handrail tubing was rolled and painted. Handrail installation is being done during the overhaul cycle and Tiger Team visits. The Safety Officer has recommended an outside independent test on the Fall Arrest System. Our insurance carrier, Liberty Mutual, is being asked to assist U.S. with expediting the testing, since the current fall arrest is inadequate and cumbersome.

The design and fabrication of a ladder hatch grab bar for the VLA antenna access hatch to improve access to the dish surface was completed and tested on Antenna 1. Modifications were made and it will be installed on Antenna 11 with further testing through the third quarter.

Repair of the skylights in the AAB south wall was accomplished. Preliminary on-the-job training for new permanent and temporary employees has been completed. Swamp cooler stands were fabricated for the Visitor Center roof. The horizontal band saw was rebuilt. Plascore material for the remainder of this year's feed cone segments has been cut. One VLBA drive motor was overhauled and painted.

Electrical

Servo - Minor changes to the new encoder upgrade are being made and several major components have been ordered. Encoder schematics are finalized and the encoder design is published on the web for other observatories. Some encoder boards have been finalized to date. Tools and equipment for new encoders have been ordered and in-house assembly of encoder boards is expected to begin midway into the third quarter.

Encoder overhauls continue during regular antenna overhaul. Additionally, new alignment procedures are being carried out that improve pointing accuracy. New VLBA brushes that prevent "threading" have been found. These new brushes will save much time since severe threading requires the machine shop to turn the armature down. Five VLBA antennas are outfitted with the new brushes. Other VLBA antennas will be outfitted with the new brushes as necessary. New replacements for obsolete/unavailable anemometers have been found and are in stock. A VLBA spare ACU was damaged during shipping; it has been restored and is now working at PT.

A NM Tech Student project has characterized, tested, and compared the servo loop to real data. Additionally, servo loop hardware was built. This effort should help with a new servo loop design for the EVLA.

The radio base station was moved into the electrical shop at the AAB for protection from the environment. Several design projects have begun for the generators. An operations display which monitors power has been designed, which produces "power bad" signals to start the generator and transfer electrical load to the generator. This design will also include improved "brownout" and "single phase" protection for the VLA Site Power. The batteries in the Control Building UPS units were changed.

HVAC - Chiller problems caused much data loss this quarter. Several problems with the Control Building chiller oil failure and startup delays in the control building have been corrected. Planned improvement in chiller response time, lead/lag trip points, and recommended times and temperatures for operator actions are in the works for the third quarter. Additionally, more effective wye-comm chiller monitoring is planned.

Replacement O_2 sensors for Personal Protective Equipment for confined space entry were ordered and an N_2 vessel to store them was designed and built. Several air conditioners required repair, ranging from Bus A/C, to Building A/C, to Antenna A/C at Los Alamos, and site swamp coolers were activated. The Contempo upgrade at North Liberty is done, completing the upgrade at all sites. Several pumps were rebuilt, including the Control Building chilled water pumps and the Paint Crew pumps. Dry air compressors for building water sprinklers were rebuilt and installed. Desiccant dryers to the paint booth were added and Marvair air conditioning units were prepared for installation at Fort Davis and Kitt Peak. VLBA Antenna temperature plots are now easily available on the web.

Electrical - Several preventive maintenance tasks were completed this quarter, including monthly inspections of antennas, HVAC and electrical systems, and lighting PMs. Preliminary ALMA planning was accomplished, and antenna move support, frequent generator operation, Lightning Protection System PMs and several maintenance tasks were completed. The power distribution for the Paint Crew equipment was checked out and improved upon. Rehearsed the site power recovery procedures.

Site & Wye

Grounds- Attempts to improve water and oxygen getting to the root system of VLA Ponderosa pine trees were done with some success. Ten of twelve trees near the VLA control building are making a good comeback. The waveguide Lightning Protection System (LPS) inspection is complete and repairs are underway. Waveguide LPS repair is expected to be completed in the third quarter. Continuation of the anode bed bimonthly watering, general ground and weekly landfill maintenance was performed. Preliminary ALMA planning meetings at the VLA site were attended to learn about upcoming site work.

Janitorial/Carpentry- Preparations for the 20th VLA Anniversary were made at the Guesthouse and the VLA Site. Boardwalk repair and painting, a new kitchen stove hood venting outdoors, and several preparations at the Site were made. Technical Services area maintenance building roofs were checked and repaired. Scheduling duties of the Janitors/Guards continue.

Track- Completed north arm's drainage repairs at CN-8 to CN-9 and extended the French Drain from CN-9 to BN-5. The new Track Tamper is now being used for tamping. Efforts are underway to mobilize the lining and leveling features, which should make for a more efficient and safer operation. Track was leveled from CN8 to CN9 and will continue from CN9 to Highway 60.

Vehicles- Vehicle preventive maintenance (PM) and repairs are continuing as needed. The grader was adapted for plowing the LPS cable over the waveguide and buses were prepared for 20th Anniversary Celebration and summer school.

Third Quarter Goals and Objectives

1. Repair of the Visitor Center roof will continue into the third quarter. Bids received by the State of New Mexico were too high: the lowest bid was $13,000 while the maximum amount from the state is $10,000. A letter has been sent to the state to reaffirm our need, and we expect the state to complete repairs in June 2000.
2. Continue installation of K- and Q-band receivers on VLA antennas as they become available.
3. Fire alarm system repairs - an earlier study reveals several dysfunctional building panels needing repair or maintenance to return to proper operating conditions. This task coincides with the recent relocation of the main fire alarm control panel in Operations.
4. Build an optical telescope to measure antenna-pointing efficiency.
5. Design and install remote start/stop function onto VLA Operations touch screen console which will allow operators to remotely start or stop VLA power generators during commercial outages.
6. Antenna drive motor tach generator replacement - a prototype design development to improve operation and reduce failure rate of motors due to brush wear.
7. Test transporter limp pump system - designed to recover from main hydraulic pump failure of transporter. Evaluation of improvements made on the system continues.
8. Begin work on VLA Vertex Room mock-up. ON HOLD
9. Revise Confined Space Safety Procedures.
10. Open inspection hole in roof of Visitor Center for contractor when repairs begin.
11. Continue drawing vectorization - two completed this month.
12. Convert drawing files to electronic database, on-going.
13. Assist as needed for ALMA prep work.
14. Get Jackson tamper operational (work out bugs).
15. West arm level and align from BW5 to BW6
16. Vehicle and equipment repairs as needed.
17. Redo exterior stucco on Guest House.

18. Install motor starter on Transporter 1.
19. Perform site wide lighting PMs.
20. Complete Waveguide LPS Repairs.
21. Continue anode bed maintenance.
22. Continue grounds maintenance (roads, landfill, etc.).
23. Continue vehicle PMs.
24. Continue roof repairs as needed.
25. Continue monthly staff coordination and project meetings to plan, schedule and review ongoing work.
26. Continue Site & Wye related PMs.
27. Continue repair work on equipment & vehicles.
28. Provide Confined Space and High Angle Rescue training.
29. Develop A-array move schedule.
30. Readjust dish panels on Antennas 2, 17 and 23.
31. Overhaul Antennas 25 and 2.
32. Perform VLA semi-annual site safety inspection.

G. TUCSON ELECTRONICS

1 mm Array, 220-250 GHz Receiver

This receiver is now in routine use. Several early operational problems have been identified and solved. We have identified two faults in this system which may be the source of the problems with baseline stability which sometimes affects wide-bandwidth measurements. This receiver is the ideal candidate for the development of automatic tuning of receivers, and the software to realize this has been developed and implemented. Although all of our receivers are tuned remotely over the computer network at the telescope site (or even tuned over the Internet from our downtown offices), the precise tuning still relies on the telescope operator closing the loop. The receiver characteristics are such that a simple lookup table of tuning parameters is not adequate to ensure optimum performance. With eight receivers to tune, this clearly puts considerable demand on the operator and can lead to inefficiency in the setup time needed for a new observer, even though the individual receiver channels are less complex to tune than our regular single-beam systems. systems. We continue to develop the automated tuning system for the 1 mm Array, with the intention of this development work being used in the receiver tuning design for ALMA.

The 8-Channel, 4-Beam, 3-millimeter System

A commercially available frequency tripler for the LO has been tested and works well at 4 K. This validates the concept of using coaxial lines to input the LO to the dewar at one third of the LO frequency. The dewar has been built and is currently being tested. The design and fabrication of the basic receiver insert has been completed. A crossed-grid polarization diplexer designed to operate at 4 K has also been constructed and tested. Until the announcement of the closure of the 12 Meter Telescope at the end of this observing season, a prototype 2-channel system was being tested in the lab. This project has now been cancelled.

New Phase-Lock Control

One of the most efficient observing modes, generally applicable to relatively narrow bandwidth observations, is frequency switching. Unlike other switching schemes, in this observing mode the object of interest is in the telescope beam and in the spectrometer passband for 100 percent of the time. At present, we are limited in our ability to frequency switch, in both switching rate and in total frequency throw, by the analog phase-lock system. We have designed, tested, and installed a digital phase-lock system into our 2/3 millimeter receiver that combines both frequency and phase control and provides faster, reliable switching over a broader frequency range. We can now routinely switch by as much as ±35 MHz, making frequency switching useable for a wide variety of research projects.

Another capability which will become practical thanks to the enhanced digital phase-lock is "sideband smear" operation. This is a powerful technique of reducing confusion in spectral line observations from features appearing in the unwanted sideband. The principles have been established during some ad hoc test observations performed at the

12 Meter Telescope, and have been described in conference proceedings. The practical implementation of a usable system at the 12 Meter has been hampered by the performance of the phase-lock system; fast switching times over a relatively large bandwidth are required. The digital phase-lock should solve these problems. Due to the announced closure of the 12 Meter Telescope in July 2000, this project has now been cancelled.

Receiver Component Servo Systems

Given the importance of the accuracy and reliability of the servo drivers for the components of the 12 Meter receivers, we have investigated these aspects on our 1 millimeter array system. By implementing a periodic test and maintenance procedure for all of the mechanical systems in these servo drivers, we have dramatically improved the accuracy, reliability, and repeatability of these systems. This will have direct impact on our ability to quickly and automatically tune all of the 12 Meter and ALMA receivers.

Quadrant Detector and Thermal Sensors

One of the main contributions to pointing changes on the 12 Meter Telescope is lateral movement of the subreflector, with respect to the main telescope surface. This is caused by unbalanced thermal effects on the subreflector support structure. We have installed a system on the 12 Meter to sense these changes; we have a laser quadrant detector to measure the lateral motion of the subreflector mount, with respect to the telescope central hub structure, and we have thermistors continuously monitoring the temperature of the feed legs and other parts of the telescope structure. We are currently trying to build up statistics to enable U.S. to understand the detailed relationship between the thermal distribution of the telescope and telescope pointing offsets. At a later date we had planned to incorporate the thermal data into our telescope pointing model to give real time pointing corrections. Due to the closure of the 12 Meter Telescope, this project has been cancelled.

New Digital Spectrometer

A new digital spectrometer, called the Millimeter Auto Correlator (MAC), has been in routine use at the 12 Meter Telescope for the 18 months. The MAC, which is a GBT correlator clone, has twice the instantaneous bandwidth currently available for our multibeam systems, and uses a single wideband sampler for each IF channel. This new design avoids the persistent platforming problems experienced with our now decommissioned hybrid correlator spectrometer. The MAC supports all of the existing single and multi-beam systems on the telescope.

Software

Continuum On-The-Fly Analysis - Eric Greisen has added tasks to the AIPS package which allow the analysis of continuum On-The-Fly (OTF) data. By employing the Emerson, Klein, Haslam deconvolution algorithm, these analysis tasks add greatly to our complement of OTF analysis software. This development has also expanded the scientific capabilities of the 12 Meter by adding continuum OTF to its complement of observing modes. Further development of this software has now been cancelled due to the closure of the 12 Meter Telescope.

ALMA - The ALMA receiver system development, laser local oscillator and cryogenics, and antenna design are all based in Tucson. The current site testing activities and logistics support are managed out of Tucson. Given the closure of the 12 Meter Telescope at the end of July 2000, all remaining Tucson staff will be committed to full time work on the ALMA project.

H. COMPUTING AND AIPS

New Hardware

We installed 13 new PCs (five high-end and eight mid-range) to replace the obsolete Sun IPXs that are still in wide use around NRAO-NM. These machines are running the Linux operating system, and are currently used by the roughly 12 summer students; after the summer students leave in August these machines will be distributed among AOC staff.

One of the AOC's old primary servers, 'old-zia' has been decommissioned. In previous years, old-zia provided email, login, NIS, and file system services to the AOC. These services have now been taken over by more modern servers.

The AOC is planning to order two new public Linux PCs as well as a number of tape drives to replace existing public and office tape systems. The two public PCs will be the first publicly accessible Linux workstations at the AOC, and be among the fastest public systems at the AOC.

Networking and Communications

The VLA-AOC communications upgrade project is nearly complete. A number of problems with user implementation and documentation arose. These problems are being resolved in cooperation with staff at the VLA site to ensure ease of use.

The PC network upgrade is approximately 50 percent complete. The goal of this effort is to put all PCs on a switched network, just as already is the case for Unix workstations. The end result is a far more efficient use of the available bandwidth. The Fiscal and Purchasing departments as well as the NT servers have been converted to switched ethernet already; conversion of electronics division PCs has begun and should be completed by mid-August.

The AOC has begun the process of replacing its entire Solaris based printing system with a new printing system called CUPS. CUPS is the same printing system that NRAO-Charlottesville adopted last year. The switchover to CUPS should occur sometime in early fall.

Operations Management System (OMS)

Observing management tools for array operations are now in regular use, running in parallel with their predecessor (cjobs.) Correlator management tools are nearly complete and will be deployed this quarter.

VLA/EVLA Online System Upgrade

Tests using CORBA were begun, and will continue. CORBA allows one to write software objects without having to be aware where those objects are. As such, CORBA is very suitable for distributed systems such as remote antenna locations. Initial tests indicate CORBA is viable. We started a study of 'use cases' for the EVLA observing model, such as proposal handling and scheduling. A connectivity test of the serial line controller was started and is showing promising results. Bench testing of the correlator controller hardware was completed successfully. Object analysis for the DRAO correlator also has been started.

A spare chassis for the VLA correlator controller arrived. A used mv167 computer will replace the mv147 currently being used in the correlator controller project.

VLBA Support

The main VLBA monitor database was moved to the new database server oort; the only databases remaining on the old servers will be shut down in the fourth quarter, replaced by new tools (OMS). This completes a VLBA database restructuring and redesign plan.

A model server (kepler) for the VLBA correlator was installed on the correlator subnet. Development and scientific validation of the server is complete. It will be deployed after reliability testing (not yet scheduled).

VLA Support

Jobserve saw a new release, which addresses a number of problems found during in-house testing by scientific staff. A second release is planned for the middle of July; this version will add support for VLA observations using the Pie Town antenna and the Pie Town fiber optic link. We intend to ship the July version to non-NRAO sites as well.

User Support, Miscellaneous

The new AOC computing division web pages are now online, and new pages are being added. This will be an ongoing project as we will make repeated passes through the entire document tree, updating pages as they become out of date. The first pass through the tree should be completed sometime this Fall.

Third Quarter Goals and Objectives

1. Complete VLA-AOC communications upgrade.
2. Order and install new tape drives on public systems.
3. Exhaustive clean-up of system files.

4. Install new CAPS printing system.
5. Remove old server 'arana' from service.
6. Order and install additional video conferencing equipment.
7. Upgrade all Linux systems to RedHat 6.2.
8. Select and order color transparency printer.
9. Order and install two high-end public Linux PCs.
10. July release of 'jobserve' with support for Pie Town.
11. Deploy the first phase of OMS, a replacement of the 'cjobs' programs and database.
12. Complete serial line controller interface for low-level i/o.
13. Construct a prototype C++ antenna object.
14. Vacate VLA tape storage room to make place for computer lab.
15. Train technical specialist in Windows support.
16. Install dedicated Web/ftp server.
17. Continue tests with CORBA.
18. Debug VLA correlator controller.
19. Finish and begin testing of array processor code.

I. AIPS++

In the last quarter our major goals were to support the first public release of AIPS++ (version 1.2), and to issue the second release (version 1.3). The second release is now issued and is being shipped. The capabilities of the second release are defined in the release notes [http://www.aips2.aoc.nrao.edu/docs/project/releasenotes13].

As described in the last quarterly report, the AIPS++ Goals for 2000 are as follows:

E 1. Support the existing releases (1.2 and 1.3) of AIPS++ by NRAO, consortium, and astronomical users.
This continues and takes about 25 percent of our time.

E 2. Support GBT commissioning and first scientific observations.
This continues. We believe that we are well situated for the expected commencement of GBT commissioning in August 2000.

E 3. Issue two main releases (1.3 and 1.4) of AIPS++, improving the completeness of scientific capabilities and thus broadening the user community.
Version 1.3 is released and shipping. As is our usual practice, immediately after the second release, we produced a development plan for the next release [http://aips2.nrao.edu/docs/notes/234/234.html]. We have been following this development plan, as well as providing support for the exising releases.

E 4. Provide simulation capabilities for ALMA within AIPS++, including construction of data sets with simulated errors, calibration and imaging, and evaluation of imaging performance
As a final part of this goal, we are currently adding simulation of pointing errors. This will conclude our work in this area for this year.

E 5. Coordinate development of calibration and imaging pipelines within AIPS++
A coordination meeting was held in Socorro in late January. This served to align the work going on at different AIPS++ sites. Further coordination will continue throughout the year.

E 6. Develop a plan for constructing an NRAO-wide Data Management System based on AIPS++, designed to deliver complete data products that make NRAO telescopes more accessible to astronomers, and incorporating the university community into the production, analysis, and archiving of these data.
Complete. A plan was presented to the Director, and after some modification, was accepted. An Associate Director for Data Management was appointed May 1, with responsibility for drawing up a Data Management plan. Further goals and progress in Data Management are given elsewhere.

I 7. Complete AIPS++ such that processing of mainstream VLA and VLBA observations can be accomplished entirely within AIPS++.
This is ongoing. For the VLA, the major work needed is to complete some areas of calibration, to improve data editing capabilities, and to improve the user interfaces. We are currently collaborating with AOC

scientific staff on intensive testing of AIPS++ for VLA data reduction. Work on the VLBA is currently deferred. We have hired a scientist/programmer to work in synthesis development.

I 8. Coordinate with the VLA Upgrade Project, the use of AIPS++ facilities with the upgraded VLA
We contributed a section on computing for the VLA Expansion proposal to address these issues. We are currently involved in discussions concerning the proposed DRAO-constructed correlator for the EVLA.

I 9. Develop a prototype calibration and imaging pipeline for the VLBA with the goal of simplifying use of the VLBAby non-experts.
This activity is still in the planning stage. As a first step, we are developing scripts for the reduction of known data sets.

I 10. Develop visualization capabilities inside AIPS++ using already secured NSF grant, with the goal of aiding processing of radio-astronomical observations into scientific results.
We have hired a scientist/programmer into Green Bank, effective April 3, and a progammer into Socorro, effective June 15. Both are currently learning the AIPS++ system.

D 11. Issue developer's prerelease of AIPS++ for development of new AIPS++ on limited and controlled platform, thereby expanding the pool of available developers outside the existing consortium
This is being developed and is expected for mid 2000.

D 12. Conduct outreach initiative to publicize AIPS++ and to educate new users
For item 12, we have continue internal workshops on the use of AIPS++ in various applications. We also conducted outreach at the AAS meeting in Atlanta. We plan to continue this at various meetings throughout the year. We also visited Arecibo in February to consult with NAIC scientists on the use of AIPS++. This has led to an ongoing informal collaboration.

J. TELESCOPE USAGE

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

	12 Meter	VLA	VLBA
Scheduled Observing (hrs)	1943.50	1719.50	1413.50
Scheduled Maintenance and Equipment Changes	78.25	212.90	216.00
Scheduled Tests and Calibration	150.25	256.70	221.00
Time Lost	91.25	112.80	60.00
Actual Observing	1852.25	1606.70	1353.50

K. VERY LARGE ARRAY OBSERVING PROGRAMS

The second quarter of 2000 was spent in the following configurations: C configuration from April 1 to June 19 and DnC configuration from June 19 to June 30.

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

No.	Observer(s)	Title
AB937	Bohringer, H. (MPIfEP, Garching) Schuecker, P. (MPIfEP, Garching) Feretti, L. (Bologna) Giovannini, G. (Bologna) Govoni, F. (Bologna)	Search of radio halos in REFLEX clusters. 20 cm
AB938	Bower, G. Falcke, H. (MPIR, Bonn) Backer, D. (UC, Berkeley)	Circular polarization in Sgr A*. 0.7, 1.3, 2, 3.6 cm
AB940	Bagchi, J. (IUCAA)	Extended sources in a distant galaxy cluster. 90 cm
AB941	Brogan, C. (Kentucky) Troland, T. (Kentucky)	H I Zeeman observations toward M16. 20 cm
AB942	Bower, G. Falcke, H. (MPIR, Bonn)	Polarization of radio sources in nearby galaxies. 3.6 cm
AB943	Best, P. (Leiden) van Dokkum, P. (Caltech) Franx, M. (Leiden)	The z = 0.83 cluster MS 1054-03. 3.6 cm
AB947	Bosma, A. (Marseille Obs) Athanassoula, E. (Marseille Obs)	Study of the galaxy NGC 4030. 20 cm
AB951	Ballantyne, D. (Cambridge) Martin, P. (Toronto) Kerton, C. (DRAO)	Blister H II region KR 140. 6 cm
AB968	Butler, B. Palmer, P. (Chicago)	Observing OH occultation events involving comet S2 linear. 20 cm
AC524	Cartwright, J. (Caltech) Taylor, G. Readhead, A. (Caltech) Pearson, T. (Caltech)	Polarization monitoring observations of 3C273. 0.7, 1.3 cm
AC538	Carilli, C. Menten, K. (MPIR, Bonn) Yun, M.	Imaging the CO emission from the z = 4.4 QSO BRI 1335-0417. 0.7, 3.6 cm

No.	Observer(s)	Title
AC540	Clarke, T.	Faraday rotation in extended radio sources in Abell clusters. 6, 20 cm
AC545	Clarke, T. Ensslin, T. (MPIfEP, Garching)	Faraday rotation in Abell 2256. 20 cm
AC548	Clarke, T.	Rotation measure of distant radio sources behind nearby galaxy clusters. 20 cm
AC551	Ciliegi, P. (Bologna) Comastri, A. (Bologna) Vignali, C. (Bologna) Fiore, F. (Rome, Italy) Giommi, P. (Rome, Italy) Antonelli, A. (Rome, Italy)	HELLAS X-ray sources. 6 cm
AC552	Chandler, C. Richer, J. (Cambridge) Gueth, F. (MPIR, Bonn)	The L1157 and L1448 protostellar jets. 0.7 cm
AC553	Cote, S. (NRC/Herzberg) Broadhurst, T. (UC, Berkeley) Carignan, C. (Montreal) Freeman, K. (Mt. Stromlo) Wyse, R. (Johns Hopkins)	H I mapping of galaxies associated with nearby LyA absorbers. 20 cm
AD429	Dennett-Thorpe, J. (Groningen/Kapteyn) Best, P. (Leiden) Kaiser, C. (MPIAP, Munich)	Depolarization in FR II radio sources. 6 cm
AD434	Dickey, J. (Minnesota) McClure-Griffiths, N. (Minnesota) Taylor, A. R. (Calgary) Gibson, S. (Calgary) Landecker, T. (DRAO) Lockman, F. J. Jackson, J. (Boston) Heyer, M. (Massachusetts) Gaensler, B. (MIT) Green, A. (Sydney)	Galactic plane H I survey - first quadrant. 20 cm
AD435	Dalcanton, J. (Washington) Weiner, B. (DTM/Carnegie) Hibbard, J. Bernstein, R. (DTM/Carnegie) West, A. (Washington)	Rotation curves of edge-on LSB galaxies. 20 cm

No.	Observer(s)	Title
AE136	Edge, A. (Durham) Frayer, D. (Caltech)	Search for CS emission in cooling flows. 0.7 cm
AF367	Feretti, L. (Bologna) Govoni, F. (Bologna) Giovannini, G. (Bologna)	New radio halos and relics from NVSS. 20 cm
AF370	Falcke, H. (MPIR, Bonn) Brunthaler, A. (MPIR, Bonn) Bower, G. 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
AG575	Greenhill, L. (CfA) Chandler, C. Herrnstein, J. (Renaissance Tech) Reid, M. (CfA)	Orion BN/KL: the maser shell around source I. 0.7 cm
AG581	Gopalswamy, N. (Catholic U.) Lara, A. (Catholic U.) Thompson, B. (NASA/GSFC)	Search for radio counterparts of coronal Moreton waves. 20, 90 cm
AG584	Gaensler, B. (MIT) McLaughlin, M. (Cornell) Nicastro, L. (CNR/IRA-Frascati)	The pulsating X-ray source SAX J0635+0533. 6, 20 cm
AG586	Gaensler, B. (MIT) Gotthelf, E. (Columbia) Vasisht, G. (JPL) Slane, P. (CfA)	Anomalous X-ray pulsars. 20, 90 cm
AG587	Gaensler, B. (MIT) Crawford, F. (MIT) Kaspi, V. (MIT) Manchester, D. (CSIRO) Camilo, F. (Columbia)	Parkes multi-beam pulsars. 6, 20 cm
AG588	Gaensler, B. (MIT) Slane, P. (CfA) Schulz, N. (MIT) Kassim, N. (NRL)	Search for a shell around the crab-like SNR G21.5-0.9. 20 cm
AG590	van Gorkom, J. (Columbia) Poggianti, B. (Padova) Wilcots, E. (Wisconsin) Verheijen, M. Zabludoff, A. (Arizona) Guhathakurta, P. (UC, Santa Cruz)	An H I survey of clusters in the local universe. 20 cm

No.	Observer(s)	Title
AG591	Gottesman, S. (Univ. of Florida) Malphrus, B. (Morehead State) Simpson, C. (Florida Int) Iyer, M. (Florida Int) Ratay, D. (Univ. of Florida)	Tidal debris in colliding galaxies. 20 cm
AH669	Hjellming, R. Rupen, M. Mioduszewski, A. (CSIRO)	Galactic black hole X-ray transients. 1.3, 2, 3.6, 6, 20 cm
AH685	Haarsma, D. (Calvin College) Hewitt, J. (MIT) Langston, G. Moore, C. (Groningen/Kapteyn)	Time delay monitoring of gravitational lens 2016+112. 3.6, 6 cm
AH689	Hofner, P. (NAIC) Cesaroni, R. (Arcetri) Rodriguez, L. (Mexico/UNAM) Marti, J. (Jaen)	High mass protostar IRAS 20126+4104. 0.7, 1.3 cm
AH695	Hunter, D. (Lowell Obs) Hunsberger, S. (Lowell Obs)	H I in irregulars without ordered rotation. 20 cm
AH702	Healy, K. (Arizona State) Claussen, M. Hester, J. (Arizona State)	Water maser activity in young low-mass stars in H II regions. 1.3 cm
AI079	Ivison, R. (U. College London) Lewis, G. (Washington) Padadopoulos, P. (Leiden) Barvainis, R. (unaffiliated)	Molecular gas in z = 4 superluminous galaxy APM 0827+5255. 0.7, 1.3, 6 cm
AK485	Kulkarni, S. (Caltech) Frail, D. Bloom, J. (Caltech) Djorgovski, S. (Caltech) Harrison, F. (Caltech)	Radio afterglows of gamma-ray bursts. 2, 3.6, 6, 20 cm
AK503	Kolpak, M. (Boston) Jackson, J. (Boston) Bania, T. (Boston) Clemens, D. (Boston) Simon, R. (Boston) Heyer, M. (Massachusetts) Dickey, J. (Minnesota) McClure-Griffiths, N. (Minnesota)	H I absorption toward sources from the BU/UMass Galactic Ring Survey. 20 cm

No.	Observer(s)	Title
AK507	Koopmans, L. (Groningen/Kapteyn) de Bruyn, A. G. (NFRA) Fassnacht, C.	Radio microlensing in the gravitational lens B1600+434. 1.3, 2, 3.6 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.
AK511	Krishnamurthi, A. (Colorado/JILA) Linsky, J. (Colorado/JILA) Osten, R. (Colorado/JILA) Brown, A. (Colorado/JILA) Gagne, M. (West Chester) Ayres, T. (Colorado/JILA)	Observations of AU mic and TZ CrB with Chandra. 2, 3.6, 6 cm
AL490	Laine, S. (Kentucky) Kotilainen, J. (Turku) Norris, R. (CSIRO) Reunanen, J. (Turku) Ryder, S. (Hawaii)	Seyfert and starburst galaxies with IR line images. 3.6 cm
AL499	Lacy, M. (UC, Davis) Ridgway, S. (Johns Hopkins)	Radio optical alignments in less luminous radio sources. 3.6, 20 cm
AL500	Laing, R. (Oxford) Parma, P. (Bologna) de Ruiter, H. (Bologna) Bridle, A. Fanti, R. (Bologna)	Decelerating relativistic jets in FRI radio galaxies. 3.6 cm
AL509	Lim, J. (SA/IAA, Taiwan) Ho, P. (CfA)	H I in low-redshift quasars. 20 cm
AL510	Lynds, R. (KPNO-NOAO) O'Neil, E. (KPNO-NOAO)	Continuum observations of NGC 6745. 6 cm
AL511	Lang, C. (Cornell) Goss, W. M.	Intrinsic magnetic field orientation and H II environment of the Snake (G359.1-0.2). 3.6, 6 cm
AM628	Mirabel, I. F. (Saclay) Rodriguez, L. (Mexico/UNAM) Dhawan, V.	Coordinated VLA and XMM observations of GRS 1915+105. 2, 3.6, 6 cm

No.	Observer(s)	Title
AM642	Mirabel, I. F. (Saclay) Dhawan, V. Gerard, E. (Meudon) Hjellming, R. Marti, J. (Jaen) Ogley, R. (Saclay) Pooley, G. (Cambridge) Rodriguez, L. (UNAM)	Search for new microquasars. 3.5 cm
AM645	Menten, K. (MPIR, Bonn) Wagner, S. (Heidelberg Obs) Appenzeller, I. (Heidelberg Obs) Carilli, C. Bertoldi, F. (MPIR, Bonn) Fricke, K. (Gottingen)	Survey of the FORS VLT deep field. 6 cm
AM649	Matthews, L. van Driel, W. (Paris Obs) Cox, A. (Wisconsin) Uson, J.	H I observations of super thin galaxies. 20 cm
AM657	McKean, J. (Manchester) Jackson, N. (Manchester) Browne, I. (Manchester) Wilkinson, P. (Manchester) Mao, S. (Manchester) Helbig, P. (Manchester)	Spectral indices at 5-12 mJy. 1.3, 2, 3.6, 6 cm
AM659	Massi, M. (MPIR, Bonn) Menten, K. (MPIR, Bonn)	Day-to-day variation of T Tauri stars. 1.3 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
AM666	Moran, E. (UC, Berkeley) Laurent-Muehleisen, S. (UC, Davis) van Breugel, W. (LLNL) Becker, R. (UC, Davis)	Origin of narrow line Seyfert 1 radio variability. 1.3, 2, 3.6, 6, 20, 90 cm
AN088	Nindos, A. (Maryland) White, S. (Maryland) Kundu, M. (Maryland) Gelfreikh, G. (Pulkovo Obs)	Search for oscillations in sunspot microwave sources. 2, 3.6 cm

No.	Observer(s)	Title
AN092	Nagar, N. (Maryland) Falcke, H. (MPIR, Bonn) Wilson, A. (Maryland)	M89 and its 10' optical jet. 20 cm
AO144	Owen, F. Eilek, J. (NMIMT)	High dynamic range 20 cm imaging of the M87 halo. 20 cm
AO147	Ogley, R. (CNRS, France) Mirabel, I. F. (Saclay) Chaty, S. (Open University) Marti, J. (Jaen) Rodriguez, L. (Mexico/UNAM) Stirling, A. (Lancashire)	Super-soft X-ray white dwarf binaries. 3.6, 6 cm
AO149	Owen, F.	Cluster radio halo candidates. 20 cm
AO151	O'Neil, K. (NAIC) Bothun, G. (Oregon) van Gorkom, J. (Columbia)	H I in four very H I-rich low surface brightness galaxies. 20 cm
AO154	O'Brien, T. (Manchester)	Classical nova V1494 Aql. 3.6, 6, 20 cm
AP380	Pooley, G. (Cambridge) Hardcastle, M. (Bristol, UK) Riley, J. (Cambridge) Alexander, P. (Cambridge) Gilbert, G. (Cambridge)	Radio jets of FRII radio sources. 3.6, 6 cm
AP392	Perlman, E. (STScI) Jones, L. (Birmingham) Scharf, C. (STScI) Ebeling, H. (Hawaii) Horner, D. (NASA/GSFC) Fairley, B. (Birmingham)	Cluster radio galaxies at high redshifts. 20 cm
AP394	Pooley, G. (Cambridge) Riley, J. (Cambridge) Alexander, P. (Cambridge) Gilbert, G. (Cambridge) Hardcastle, M. (Bristol, UK)	Radio jets and dynamics of FRII radio sources. 3.6 cm
AP395	Perlman, E. (STScI) Landt, H. (STScI) Padovani, P. (STScI)	X-ray bright flat spectrum radio quasars. 20 cm
AP400	Palmer, P. (Chicago) de Pater, I. (UC, Berkeley) Snyder, L. (Illinois)	OH imaging of comet LINEAR (C/1999 S4). 20 cm

No.	Observer(s)	Title
AR428	Reynaud, D. (CNRS, France) Downes, D. (IRAM) Roussel, H. (CNRS, France) Vigroux, L. (CNRS, France) Beck, R. (MPIR, Bonn)	Magnetic fields in the barred spiral NGC 1530. 3.6, 6 cm
AR429	Roberts, M. Hogg, D.	Mild tidal interactions between galaxies. 20 cm
AR432	Rosenberg, J. (Massachusetts) Schneider, S. (Massachusetts)	H I imaging of low surface brightness galaxies. 20 cm
AR434	Rosenberg, J. (Massachusetts) Schneider, S. (Massachusetts)	VLA imaging of low H I mass galaxies. 20 cm
AR435	Rudnick, L. (Minnesota) Koralsky, B. (Minnesota) Petre, R. (NASA/GSFC) Gotthelf, E. (Columbia) Holt, S. (NASA/GSFC)	Cas A: probing the X-ray/radio connections. 6 cm
AR436	Roberts, M. (Stanford) Romani, R. (Stanford) Gaensler, B. (MIT)	Unidentified GeV sources in the galactic plane. 6, 20 cm
AR437	Rodriguez, L. (Mexico/UNAM) Girat, J. (Illinois) Curiel, S. (Mexico/UNAM)	IR protostar YLW 15. 0.7, 3.6, 6 cm
AR438	Reid, M (CfA) Menten, K. (MPIR, Bonn)	Is the radio emission from long period variables stable? 3.6 cm
AS568	Sramek, R. Weiler, K. (NRL) Van Dyk, S. (UCLA) Panagia, N. (STScI)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS678	Shepherd, D. Kurtz, S. (Mexico/UNAM) Testi, L. (Arcetri)	Disk and jet parameters of the source powering the W75N outflow. 0.7 cm
AS680	Skinner, S. (Colorado/JILA) Gagne, M. (West Chester)	Simultaneous VLA/Chandra observations of the Rho Oph area. 3.6, 6 cm
AS683	Su, Y. (NCU, Taiwan) Lim, J. (SA/IAA, Taiwan) Ho, P. (CfA)	The free-free emission of candidate massive protostars. 0.7, 1.3, 2, 3.6 cm

No.	Observer(s)	Title
AS684	Sarma, A. (Kentucky) Troland, T. (Kentucky) Brogan, C. (Kentucky)	H I and OH Zeeman toward Cas A. 20 cm
AT229	Taylor, G. Fabian, A. (Cambridge) Allen, S. (Cambridge) Govoni, F. (Bologna)	Faraday rotation study of the 3C129 cooling flow cluster. 3.6, 6 cm
AT235	Trinidad, M. (Mexico/UNAM) Curiel, S. (Mexico/UNAM) D'Alessio, P. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM)	Circumbinary disk structures around binary YSOs. 0.7, 3.6 cm
AT237	Thomas, H. (Cambridge) Green, D. (Cambridge) Alexander, P. (Cambridge) Eales, S. (U. College Cardiff)	H I observations of galaxies in the JCMT/SCUBA galaxy survey. 20 cm
AT241	Thomas, H. (Cambridge) Green, D. (Cambridge) Alexander, P. (Cambridge) Eales, S. (U. College Cardiff)	H I observations of small galaxies in the JCMT/SCUBA galaxy survey. 20 cm
AU072	Uson, J. van Gorkom, J. (Columbia) Shambrook, A. (UC, Santa Cruz)	H I mapping of Abell 2029. 20 cm
AU082	Umana, G. (Bologna) Trigilio, C. (Bologna) Stanghellini, C. (Bologna) Scuderi, S. (Bologna)	Radio spectrum of two stars in Cyg OB 2. 0.7, 1.3, 2, 3.6, 6 cm
AV241	Vergani, D. (Bonn U.) Dettmar, R. (Bochum) Klein, U. (Bonn U.)	H I in disk galaxies with merging bulges. 20 cm
AW362	White, S. (Maryland)	The stellar activity cycle on active stars. 3.6, 6, 20 cm
AW519	Wilcots, E. (Wisconsin) Bershady, M. (Wisconsin) Jangren, A. (Penn State)	Low redshift, luminous, compact star forming galaxies. 2 cm
AW528	van der Walt, J. (Potchefstroom) Churchwell, E. (Wisconsin) Gaylard, M. (HartRAO) Goedhardt, S. (HartRAO)	Continuum emission from class II methanol masers. 3.6 cm

No.	Observer(s)	Title
AW530	Wrobel, J. Walker, R. C. Schwartz, C. (UC, Santa Barbara) Laing, R. (Oxford) Bridle, A.	Proper motions in the FRI radio galaxy M84. 6 cm
AW531	Wolter, A. (Brera Obs) Rector, T. (KPNO-NOAO) Maccacaro, T. (Brera Obs) Stocke, J. (Colorado/JILA)	Radio spectral properties of X-ray selected BL lac objects. 2, 3.6, 6, 20 cm
AW535	Wilcots, E. (Wisconsin) Armandroff, T. (KPNO-NOAO) Caldwell, N. (CfA)	Gas content of F8D1, a low surface brightness galaxy in the M81 grp. 20 cm
AW536	Wong, T. (UC, Berkeley) Thornley, M. Blitz, L. (UC, Berkeley) Bock, D. (UC, Berkeley) Helfer, T. (Arizona) Regan, M. (DTM/Carnegie) Sheth, K. (Maryland) Vogel, S. (Maryland)	H I in nearby spirals with CO observations. 20 cm
AW537	Willson, R. (Tufts) Erdelyi, R. (Sheffield) Doyle, G. (Armagh Obs)	Micro-flaring on the sun. 3.6, 6 cm
AX007	Xu, C. (IPAC) Condon, J.	The intra-cluster starburst in Stephan's quintet. 6, 20 cm
AY086	Yun, M. del Olmo, A. (IAA, Granada) Huchmeier, W. (MPIR, Bonn) Perea, J. (IAA, Granada) Verdes-Montenegro, L. (IAA, Granada)	H I clouds in the densest compact groups. 21 cm
AY102	Yun, M. Hibbard, J.	Giant radio plumes around IR luminous galaxies. 20 cm
AY111	Yin, Q. Huang, J. (Nanking) Zheng, W. (Johns Hopkins)	Two newly discovered Wolf-Rayet galaxies. 6 cm
AY114	Yu, K. (Colorado/JILA) Bally, J. (Colorado/JILA)	Search for 1720 Hz OH masers from YSO outflows. 20 cm

No.	Observer(s)	Title
AY115	Yusef-Zadeh, F. (Northwestern) Roberts, D. (Illinois) Wardle, M. (Sydney)	Extended nature of OH emission from G357.7+0.03. 20 cm
AZ114	Zhang, Q. (CfA) Ho, P. (CfA) Hunter, T. (CfA) Sridharan, T. (CfA)	Search for disks around intermediate to high mass young stars. 1.3 cm
AZ120	Zhang, Q. (CfA) Hunter, T. (CfA) Sridharan, T. (CfA) Ho, P. (CfA)	Disk/Jet system around the high-mass young star in AFGL 5142. 1.3 cm line
AZ121	van Zee, L. (DAO) Salzer, J. (Wesleyan U.) Taylor, C. (Ruhr U.) Norton, S. (UC, Santa Cruz)	H I in compact dwarf irregular galaxies. 20 cm
AZ122	van Zee, L. (DAO) Salzer, J. (Wesleyan U.) Skillman, E. (Minnesota)	BCD rotation curves: is the mass distribution centrally concentrated. 20 cm
AZ123	Zhao, J. (CfA) Goss, W. M. Anantharamaiah, K. (Raman Institute) Viallefond, F. (Paris Obs)	Hydrogen recombination from Arp 220 and M82. 0.7, 1.3 cm
AZ124	Zwaan, M. (Groningen/Kapteyn) van Dokkum, P. (Caltech) Verheijen, M. Briggs, F. (Groningen/Kapteyn)	H I imaging of galaxy cluster Abell cluster 1689 at z = 0.181. 20 cm
AZ128	Zhao, J-H. (CfA) Bower, G. Goss, W. M.	Monitoring Sgr A*. 0.7, 1.3, 2 cm
BG086	Gomez, J-L. (IAA, Andalucia) Marscher, A. (Boston) Alberdi, A. (IAA, Andalucia) Gabuzda, D. (NFRA)	Lac object 0735+178. 0.7, 1.3, 2 cm
BG098	Greenhill, L. (CfA) Diamond, P. (Manchester) Moran, J. (CfA)	Maser motions and outflow in a solar system sized region around a 10^5 L YSO. 7 cm
BI017	Ishihara, Y. (Nobeyama, Japan) Nakai, N. (Nobeyama, Japan)	High velocity features of water maser in the Seyfert IC 2560. 1.3 cm

No.	Observer(s)	Title
BJ031	Junor, W. (UNM) Biretta, J. (STScI) Wardle, J. (Brandeis)	VLBA U, K, Q, polarimetric imaging of Virgo A. 0.7, 1.3, 2 cm
BJ033	Jones, D.L. (JPL) Wehrle, A. (JPL)	Search for parsec scale absorption in NGC 6251. 2, 6, 18 cm
BK073	Kellermann, K. Biretta, J. (STScI) Owen, F. Junor, B. (UNM)	Kinematics of the parsec and subparsec structure of the M87 jet. 2 cm
BL058	Lonsdale, C. (Haystack) Diamond, P. (Manchester) Smith, H. (UC, San Diego) Lonsdale, C. (IPAC)	VLBA monitoring of the radio supernovae in the OH megamaser galaxy Arp 220. 3.6, 6, 18 cm
BM116	Marscher, A.P. (Boston) Cawthorne, T. (Lancashire) Gear, W. (Mullard) Stevens, J. (Mullard) Marchenko, S. (Boston) Lister, M. (JPL) Gabuzda, D.C. (Lebedev) Yurchenko, A. (St. Petersburg) Forster, J.R. (Hat Creek)	Evolution of total and polarized intensity of AGN at high radio frequencies. 0.7 cm
BM124	Mundell, C. (Liverpool) Wilson, A. (Maryland) Ulvestad, J. Roy, A. (MPIR, Bonn)	Subparsec-scale thermal emission from Seyfert accretion disks. 3.6 cm
BN013	Nagar, N. (Maryland) Peck, A. (MPIR, Bonn) Mundell, C. (Maryland)	Investigating the kinematics of the obscuring gas in the LINER NGC 6500. 21 cm
BP061	Phillips, R.. (Haystack) Boboltz, D. (USNO)	Monitoring the 43 GHz SiO maser emission towards MIRA. 0.7 cm
BP066	Palen, S. (Washington)	Magnetic fields in asymptotic giant branch stars and proto-planetary nebulae. 18 cm
BR067	Ratner, M. (CfA) Bartel, N. (York) Bietenholz, M. (York) Lebach, D. (CfA) Lestrade, J-F. (Meudon) Ranson, R. (York) Shapiro, I. (CfA)	Astrometry of HR 8703 in 2000 for the gravity Probe-B mission. 2, 3.6 cm

No.	Observer(s)	Title
BS078	Sanchez-Contreras, C. (OAN, Spain) Desmurs, J.F. (OAN, Spain) Bujarrabal, V. (OAN, Spain) Colomer, F. (OAN, Spain) Alcolea, J. (OAN, Spain)	SiO masers from the protoplanetary nebula OH231.8+4.2. 0.7 cm
BU019	Uson, J. Beasley, A.	Spatial and spectral resolution of the H I absorption in 0902+343 at z = 3.4. 90 cm
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 v = 2 43 GHz SiO masers in two Mira variables, R Cas and TX Cam. 0.7 cm
GG041	Gabuzda, D.C. (JIVE) Gurvits, L.I. (JIVE)	Magnetic field structure in high redshift quasars. 6 cm
GM035	Marcaide, J. (Valencia) Perez-Torres, M. (Valencia) Guirado, J. (Valencia) Alberdi, A. (LAEFF) Ros, E. (MPIR, Bonn) Diamond, P. (Manchester) Shapiro, I. (CfA) Preston, R. (JPL) Schilizzi, R. (JIVE) Mantovani, F. (IRA) Trigilio, C. (IRA) Van Dyk, S. (UCLA) Weiler, K. (NRL) Sramek, R. Whitney, A. (Haystack)	Monitoring of the expansion of SN 1993J. 6, 18 cm
GR021	Paredes, J.M. (Barcelona) Ribo, M. (Barcelona) Marti, J. (Jaen) Massi, M. (MPIR, Bonn)	Exploring the jets of a new micro quasar. 6 cm

L. VERY LONG BASELINE ARRAY OBSERVING PROGRAMS

No.	Observer(s)	Title
BB108	Moscadelli, L. (Cagliari, Italy)	Testing the Galactic center scattering law with interstellar hydroxy 1 and methanol masers. 2 cm

No.	Observer(s)	Title
BB116	Beasley, A. Herrnstein, J. (Renaissance Tech)	Non-thermal emission from O supergiants. 3.6 cm
BB118	Brisken, W. (Princeton) Benson, J. Fomalont, E. Goss, W. M. Thorsett, S. (UC, Santa Cruz)	Parallaxes of ten nearby radio pulsars. 18 cm
BB120	Boboltz, D. (USNO) Gaume, R. (USNO) Fey, A. (USNO) Hajian, A. (USNO) Hummel, C. (USNO) Johnston, K. (USNO)	Simultaneous VLBA/NPOI observations of radio stars. 3.6 cm
BB122	Baudry, A. (Bordeaux) Diamond, P. (Manchester)	Second epoch observations of the 13.4 GHz OH maser in W3 (OH). 2 cm
BB123	Brotherton, M. (KPNO-NOAO) Lacy, M. (UC, Davis) Laurent-Muehleisen, S. (UC, Davis) Becker, R. (UC, Davis) Gregg, M. (UC, Davis) Beasley, A.	Radio bright broad absorption line quasars. 18 cm
BB124	Beasley, A. Herrnstein, J. (Renaissance Tech)	Monitoring of WR140. 3.6, 6, 18 cm
BC101	Claussen, M. Goss, W. M. Desai, K. (Renaissance Tech) Frail, D.	1720 MHz OH masers in IC 443. 18 cm
BC103	Chatterjee, S. (Cornell) Cordes, J. (Cornell) Goss, W. M. Fomalont, E. Beasley, A. Benson, J. Lazio, T. J. W. (NRL) Arzoumanian, Z. (NASA/GSFC)	Gated VLBA pulsar astrometry. 18 cm
BC106	Coles, W. (UC-San Diego)	Solar wind speed using IPS. 1.3, 2, 3.6, 6 cm
BD056	Di Matteo, T. (CfA) Carilli, C. Fabian, A. (IoA)	VLBA multi-frequency observations: crucial test for ADAF paradigm in nearby dead quasars. 2, 4 cm

No.	Observer(s)	Title
BD060	Dhawan, V. Kellermann, K. Romney, J.	Monitoring the accelerating, bent jet in 3C84. 0.7 cm
BD062	Diamond, P. (Manchester) Kemball, A.	TX Cam: the sequel. 0.7 cm
BD064	Desai, K. (Renaissance Tech) Anantharamaiah, K. (RRI) Golap, K.	Scattering in the solar wind at large elongations. 2, 4, 13, 20 cm
BD069	Diamond, P. (Manchester) Kemball, A.	TX Cam: the final curtain. 0.7 cm
BE020	Edwards, P. (ISAS) Murphy, D. (JPL) Tingay, S. (CSIRO)	Optical jet sources. 4 cm
BF058	Falcke, H. (MPIR, Bonn) Reid, M. (CfA) Henkel, C. (MPIR, Bonn) Brunthaler, A. (MPIR, Bonn)	Towards measuring proper motions of local group galaxies. 1.3 cm
BF061	Filho, M. (Kapteyn) Ho, L. (Carnegie) Barthel, P. (Kapteyn) Falcke, H. (MPIR, Bonn) Nagar, N. (Maryland) Wilson, A. (Maryland)	Incidence and properties of parsec scale radio cores in transition. 6 cm
BG073	Gomez, J-L. (IAA, Andalucia) Alberdi, A. (IAA, Andalucia) Marscher, A. (Boston)	Comparison of observed and simulated relativistic jets: 22 and 43 GHz monitoring observations of the radio galaxy 3C 120. 0.7, 1 cm
BG086	Gomez, J-L. (IAA, Andalucia) Marscher, A. (Boston) Alberdi, A. (IAA, Andalucia) Gabuzda, D. (NFRA)	BL Lac object 0735+178. 0.7, 1.3, 2 cm
BG098	Greenhill, L. (CfA) Diamond, P. (Manchester) Moran, J. (CfA)	Maser motions in Orion BN/KL. 0.7 cm

No.	Observer(s)	Title
BG099	Gomez, J-L. (IAA, Andalucia) Agudo, I. (IAA, Andalucia) Marscher, A. (Boston) Marchenko, S. (Boston) Alberdi, A. (IAA, Andalucia) Garcia-Miro, C. (IAA, Andalucia) Cawthorne, T. (Lancashire)	Polarization of sources with compact stationary components. 0.7, 1.3, 2 cm
BG100	Gwinn, C. (UC, Santa Barbara) Hirano, C. (UC, Santa Barbara)	Size of the Vela pulsar's emission region at 5 and 0.66 GHz. 6 cm
BG101	Gallimore, J. Genzel, R. (MPE, Garching) Tacconi, L. (MPE, Garching)	Possible new radio supernoa in the merger remnant NGC 6240. 13 cm
BI017	Ishihara, Y. (NAO, Japan) Nakai, N. (NAO, Japan) Diamond, P. (Manchester)	High velocity features of water maser in the Seyfert IC 2560. 1.3 cm
BJ031	Junor, W. (New Mexico) Biretta, J. (STScI) Wardle, J. (Brandeis)	Polarmetric imaging of Virgo A. 0.7, 1.3, 2 cm
BJ032	Johnston, K. (USNO) Fey, A. (USNO) Gaume, R. (USNO) Clark, T. (NASA/GSFC) Ma, C. (NASA/GSFC) Eubanks, T. M. (USNO) Kingham, K. (USNO) Boboltz, D. (USNO) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) Shaffer, D. (Radiometrics) Gordon, D. (NASA/GSFC) Fomalont, E. Walker, R. C.	VLBA geodesy/astrometry observations for 2000. 3.6 cm
BJ033	Jones, D. (JPL) Wehrle, A. (JPL)	Search for parsec-scale absorption in NGC 6251. 2, 3.6, 6, 18 cm
BK073	Kellermann, K. Biretta, J. (STScI) Owen, F. Junor, W. (New Mexico)	Kinematics of parsec and subparsec structure of M87 jet. 2 cm

No.	Observer(s)	Title
BK074	Kameno, S. (NAO, Japan) Sawada-Satoh, S. (ISAS, Japan) Wajima, K. (NAO, Japan) Zhi-Qiang, S. (NAO, Japan)	Complementary multi-frequency VSOP and VLBA survey for GPS sources. 1 cm
BK075	Kedziora-Chudczer, L. (ATNF) Bignall, H. (Adelaide) Jauncey, D. (ATNF) Lovell, J. (ATNF) Nicolson, G. (HartRAO) Perley, R. Reynolds, J. (ATNF) Tzioumis, A. (ATNF) Wieringa, M. (ATNF)	Structural variability of the four southern extreme IDV sources. 1, 6 cm
BL058	Lonsdale, C. (Haystack) Diamond, P. (Manchester) Smith, H. (UC, San Diego) Lonsdale, C. (Caltech)	Radio supernovae in OH megamaser galaxy Arp220. 3.6, 6, 18 cm
BL075	Lovell, J. (CSIRO) Reynolds, J. (CSIRO) Weiringa, M. (CSIRO) Jauncey, D. (CSIRO) King, E. (CSIRO) Tzioumis, A. (CSIRO) Edwards, P. (ISAS, Japan) McCulloch, P. (Tasmania) Jones, D. (JPL)	Monitoring the compact structure in PKS 1830-211. 1.3, 2, 3.6 cm
BL080	Lobanov, A. (MPIR, Bonn) Giesecke, A. (MPIR, Bonn) Klare, J. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn)	Multi-frequency monitoring of parsec-scale jet in 3C345. 1, 2, 4, 6 cm
BL081	Lister, M. (JPL) Gower, A. (Victoria)	Investigating anomalously bright cores in classical double-lobed quasars. 6, 20 cm
BL086	Lobanov, A. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn)	Monitoring of the ongoing flare in the VLBI core of 3C 345. 0.7, 1, 2 cm
BM110	Mutel, R. (Iowa) Denn, G. (Iowa)	Monitoring BL Lac. 0.7, 1.3, 2 cm

No.	Observer(s)	Title
BM112	Moran, J. (CfA) Bragg, A. (CfA) Diamond, P. (Manchester) Greenhill, L. (CfA) Henkel, C. (MPIR, Bonn) Trotter, A. (CfA)	Next generation study of NGC 4258 accretion disk physics from measurement of month to month variations. 1 cm
BM116	Marscher, A. (Boston) Cawthorne, T. (Lancashire) Gear, W. (Wales) Stevens, J. (Cambridge) Marchenko, S. (Boston) Lister, M. (JPL) Gabuzda, D. (NFRA) Yurchenko, A. (St. Petersburg) Forster, J. (UC, Berkeley)	Monitoring millimeter-bright AGN. 0.7 cm
BM123	Guirado, J. (Valencia) Perez-Torres, M. (Valencia) Ros, E. (MPIR, Bonn)	Multi-wavelength absolute kinematics in the S5 polar sample. 2 cm
BM124	Mundell, C. (Maryland) Wilson, A. (Maryland) Ulvestad, J. Roy, A. (MPIR, Bonn)	Subparsec scale thermal emission from Seyfert accretion disks. 3.6 cm
BM126	Mioduszewski, A. (ATNF) Hjellming, R. Rupen, M.	T of O Observations of the X-ray Binary Cygnus X-3 during and after a large flare. 2, 4, 6, 20 cm
BM129	Murphy, D. (JPL) Marshall, H. (MIT) Canizares, C. (MIT) Coppi, P. (Yale) Preston, R. (JPL) Piner, G. (JPL) Lister, M. (JPL) Edwards, P. (ISAS, Japan) Hirabayashi, H. (ISAS, Japan)	Chandra and VLBA observations of 3C273 and 1156+295. 0.7, 1.3, 2, 3.6 cm
BM133	Moran, E. (UC-Berkeley) Becker, R. (IRAM) Laurent-Mueleisen, S. (Livermore) van Breugel, W. (Livermore)	Parsec-scale radio morphology of narrow line Seyfert 1 galaxies. 6 cm

No.	Observer(s)	Title
BN009	Koopmans, L. (Groningen) Norbury, M. (Manchester) Blandford, R. (Caltech) Jackson, N. (Manchester) Koopmans, L. (Groningen) Myers, S. Pearson, T. (Caltech) Readhead, A. (Caltech) Rusin, D. (Pennsylvania)	Long-track observations of top CLASS lens candidates. 20 cm
BN013	Nagar, N. (Maryland) Peck, A. (MPIR, Bonn) Mundell, C. (Maryland)	Neutral hydrogen absorption in the LINER NGC 6500. 18 cm
BO008	Ogley, R. (Saclay) Chaty, S. (Open University) Dhawan, V. Hjellming, R. Marti, J. (Jaen) Mirabel, I. F. (Saclay) Pooley, G. (Cambridge) Rodriguez, L. (Mexico/UNAM)	Search for new microquasars. 2, 4, 13 cm
BP052	Pyatunina, T. (St. Petersburg) Gabuzda, D. (JIVE) Marchenko, S. (Boston)	Multi-frequency polarization imaging of 0059+581 and 1739+522. 1, 2, 4, 6 cm
BP053	Polatidis, A. (NFRA) Conway, J. (Chalmers, Onsala) Murphy, D. (JPL)	Continued coordinated monitoring of 1928+738. 0.7, 2 cm
BP059	Patel, N. (CfA) Greenhill, L. (CfA) Herrnstein, J. (Renaissance Tech) Ho, P. (CfA) Moran, J. (CfA) Patel, N. (CfA) Zhang, Q. (CfA)	Kinematics of gas within a few AU around IRAS 21391+5802. 1 cm
BP061	Phillips, R. (Haystack) Boboltz, D. (USNO)	Monitoring of 43 GHz SiO maser emission towards MIRA. 0.7 cm
BP062	Piner, B. (JPL) Edwards, P. (ISAS)	Multi-epoch 15 GHz observations of the TeV sources 2155-304 and 1 ES 1959+650: completion of a TeV selected sample. 2 cm
BP066	Palen, S. (Washington)	OH main line masers in PPN. 18 cm

No.	Observer(s)	Title
BP073	Peck, A. (MPIR, Bonn) Falcke, H. (MPIR, Bonn) Gallimore, J. Hagiwara, Y. (MPIR, Bonn) Henkel, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Ulvestad, J.	Water maser in Mrk 348. 1 cm
BR067	Ratner, M. (CfA) Bartel, N. (York U.) Bietenholz, M. (York U.) Lebach, D. (CfA) Lestrade, J-F. (Paris Obs) Ransom, R. (York U.) Shapiro, I. (CfA)	Astrometry of IM Peg in 2000 for the Gravity Probe-B mission. 2, 3.6, 6 cm
BR068	Roy, A. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Mundell, C. (John Moores) Ulvestad, J. Wilson, A. (Maryland)	Component motions un NGC 5506. 6, 20 cm
BS078	Sanchez, C. (Yebes Obs) Desmurs, J. (Yebes Obs) Bujarrabal, V. (Yebes Obs) Colomer, F. (Yebes Obs) Alcolea, J. (Yebes Obs)	SiO masers from the proto planetary nebula OH231.8+4.2. 0.7 cm
BS081	Strelnitski, V. (Maria Mitchell) Benson, P. (Wellesley) Kogan, L. Salter, D. (Wellesley)	Multi-epoch imaging of VX U Ma in the 1.35 com H_20. 1 cm
BT037	Tingay, S. (JPL)	Probing the core and pc-scale jet of a nearby gamma-ray AGN, PKS 0521-365. 1, 4, 6 cm
BT044	Taylor, G. Beasley, A. Frail, D. Kulkarni, S. (Caltech)	Observations of gamma-ray bursters. 4 cm
BT051	Taylor, G. Zavala, B. (NMSU)	Faraday rotation measure study of the AGN environment. 2, 4 cm
BU019	Uson, J. Beasley, A.	H I absorption in 0902+343 at z=3.4. 90 cm

No.	Observer(s)	Title
BV040	Vlemmings, W. (Leiden) Baudry, A. (Bordeaux) Diamond, P. (Manchester) Habing, H. (Leiden) Schillizzi, R. (JIVE) van Langevelde, H. (JIVE)	Monitoring the amplified stellar image in 4 AGB stars. 20 cm
BW044	Wilson, A. (Maryland) Mundell, C. (Maryland) Nagar, N. (Maryland) Ulvestad, J.	Testing the AGN and megamaser paradigms with all VLBA observable H_20 megamasers. 4, 6, 20 cm
BW046	Wrobel, J. Fassnacht, C. Ho, L. (Carnegie)	Subparsec structure of the Seyfert 1 nucleus of NGC 4395. 20 cm
BW047	Winn, J. (MIT) Hewitt, J. (MIT) Patnaik, A. (MPIR, Bonn) Schechter, P. (MIT)	Snapshot survey of gravitational lens candidates. 6, 20 cm
BW048	Wardle, J. (Brandeis) Attridge, J. (Haystack) Elvis, M. (CfA) Homan, D. (Brandeis) Mathur, S. (Ohio)	Observations of X-ray/UV warm absorber in the quasar 3C212. 2, 4 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
GG041	Gabuzda, D. (NFRA) Gurvits, L. (NFRA)	Magnetic field structure in high redshift quasars. 3.6, 6 cm
GG042	Greenhill, L. (CfA)	Why is the maser accretion disk in NGC 1068 unlike the one in NGC 4258? 1, 4 cm

No.	Observer(s)	Title
GM035	Marcaide, J. (Valencia) Perez-Torres, M. (Bologna) Guirado, J. (Valencia) Alberdi, A. (IAA, Andalucia) Ros, E. (MPIR, Bonn) Diamond, P. (Manchester) Shapiro, I. (CfA) Preston, R. (JPL) Schilizzi, R. (NFRA) Mantovani, F. (Bologna) Trigilio, C. (Bologna) Van Dyk, S. (UCLA) Weiler, K. (NRL) Sramek, R. Whitney, A. (Haystack)	Monitoring of the expansion of SN 1993J. 6, 18 cm.
GO003	Owsianik, I. (MPIR, Bonn) Conway, J. (Chalmers, Onsala) Polatidis, A. (NFRA)	Component spectra in CSOs. 18 cm
GP025	Paragi, Z. (FOMI) Fejes, I. (FOMI) Vermeulen, R. (NFRA) Schilizzi, R. (NFRA) Spencer, R. (Manchester) Stirling, A. (Lancashire)	Anomalous equatorial emission region of SS 433. 18 cm
GR021	Paredes, J. (Barcelona) Ribo, M. (Barcelona) Marti, J. (Jaen) Massi, M. (MPIR, Bonn)	A new microquasar candidate: LS 5039. 6 cm
TF015	Foley, L.	Fringe Finders. 0.7, 1, 2, 4, 6, 13, 20 cm
V028	Bower, G.	Compact Core of NRAO 530. 18 cm
W004	Venturi, T. (Bologna) Bondi, M. (Bologna) Dallacasa, D. (Bologna) Fanti, R. (Bologna) Mantovani, F. (Bologna) Padrielli, L. (Bologna) Stanghellini, C. (Bologna) Comastri, A. (Bologna) Ferrari, A. (Torino)	Gamma-ray loud blazars. 6 cm

No.	Observer(s)	Title
W030	Tingay, S. (CSIRO) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) King, E. (CSIRO) Edwards, P. (ISAS, Japan) Lovell, J. (CSIRO) Hirabayashi, H. (ISAS, Japan) McCulloch, P. (Tasmania)	Gamma-ray loud and quiet AGN. 6 cm
W059	Kedziora-Chudczer, L. (AAO) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) Wieringa, M. (CSIRO) Nicolson, G. (HartRAO) Quick, J. (HartRAO) Walker, M. (Sydney) McCulloch, P. (Tasmania)	Complete sample of intra-day variables. 6 cm
W088	Roberts, D. (Illinois) Moellenbrock, G. Wardle, J. (Brandeis) Gabuzda, D. (NFRA) Brown, L. (Connecticut)	Polarization monitoring of four bright quasars at 5 and 1.6 GHz. 18 cm

M. 12 METER OBSERVING PROGRAMS

No.	Observer(s)	Title
B697	Buckle, J. (Manchester) Fuller, G. (Manchester) Hatchell, J. (Manchester)	Study of sulphur chemistry in protostellar outflows.
B699	Boselli, A. (Marseille Obs) Gavazzi, G. (Milano Obs) Lequeux, J. (DEMIRM, Paris)	A CO survey of a complete sample of late-type galaxies in the Virgo cluster.
B700	Blitz, L. (UC, Berkeley)	Study of molecular gas in a dwarf galaxy.
C326	Clancy, R. T. (SSI, Boulder) Sandor, B. (High Altitude Obs)	Thermal and compositional studies of the Mars and Venus atmospheres.
CA01	Attridge, J. (Haystack), et al.	Polarization of strong quasars.

No.	Observer(s)	Title
CD18	Doeleman, S. (Haystack) Lonsdale, C. (Haystack) Barvainis, R. (Haystack) Phillips, R. (Haystack) Greenhill, L. (CfA)	86 GHz imaging of the SiO masers in the Orion-KL nebula.
CJO4	Junor, W. (New Mexico), et al.	Study of 3C274 core structure.
CK09	Krichbaum, T. (MPIR, Bonn) Klare, J. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn	A study of subluminal kinematics in the inner jet and counter-jet of 3C84.
CK10	Krichbaum, T. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn Greve, A. (IRAM) Ungerechts, H. (IRAM) Teräsranta, H. (Helsinki)	Continued 86 GHz VLBI monitoring of BL Lac after multiple optical flares.
CP06	Phillips, R. (Haystack) Boboltz, D. (Haystack)	Monitoring of the 86 and 43 GHz Sio maser emission towards Mira.
CS07	Shen, Z. (SA/IAA, Taiwan) Moran, J. (CfA) Kellermann, K. Inoue, M. (SA/IAA, Taiwan)	Probing a superluminal bent jet within 1 parsec of the core of PKS 1921-293 with three-epoch CMVA imaging.
D201	Doeleman, S. (Haystack) Phillips, R. (Haystack)	VLBI observations of SiO masers on the Kitt Peak-SMTO baseline, 2 mm.
E65	Evans, A. (Caltech) Sanders, D. (Hawaii) Mazzarella, J. (IPAC)	CO (1-0) observations of powerful FR II radio galaxies detected by IRAS.
E69	Ehrenfreund, P. (Leiden) Charnley, (NASA/Ames) Butner, H. (Arizona) Ruiterkamp, R. (Leiden)	Study of the organic composition of star-forming cores seen by ISO and their relation to cometary ices.
E70	Engargiola, G. (UC, Berkeley) Plambeck, R. (UC, Berkeley) Mangum, J.	Hunting for YSOs in a smooth black blob: combined interferometric and single-dish survey of B133.
G368	Gao, Y. (Toronto) Gruendl, R. (Illinois) Lo, K. Y. (SA/IAA, Taiwan) Hwang, C-Y. (SA/IAA, Taiwan)	Study of the widely separated ultraluminous infrared galaxies.

No.	Observer(s)	Title
G375	Gallimore, J. Thornley, M.	Are the nuclei of Seyfert galaxies gas-rich compared to normal galaxies?
H344	Hollis, M. (NASA/GSFC) Lovas, F. (NIST) Jewell, P.	Identification of interstellar glycolaldehyde.
H345	Hogg, D.	Study of stellar wind bubbles and molecular gas.
H346	Helfter, T. (UC, Berkeley) Thornley, M. Regan, M. (DTM/Carnegie) Sheth, K. (Maryland) Vogel, S. (Maryland) Harris, A. (Maryland) Wong, T. (UC, Berkeley) Bock, D. (UC, Berkeley) Blitz, L. (UC, Berkeley)	Continuing program: Single-dish data for BIMA SONG.
H347	Horn, J. (UCLA) Morris, M. (UCLA) Uchida, K. (Ohio State)	Study of molecular gas in the giant HI cloud surrounding the blue compact galaxy II Zw 44.
K365	Kuan, Y-J. (ASIAA, Taiwan) Charnley, S. (NASA/Ames) Rodgers, S. (NASA/NRC) Butner, H. (Arizona) Snyder, L. (Illinois)	Search for azaheterocyclic interstellar molecules.
L345	Di, L. (Cornell) Goldsmith, P. (Cornell)	Study of massive star formation: density of cold cores in GMCs.
L347	Lubowich, D. (Hofstra)	A comparison between the DCN/HCN, D/H, and DCO^+/HCO^+ ratios in the 20 km/s and 50 km/s Sgr A molecular clouds.
L350	Larinov, G. (Lebedev) Promislov, V. (Lebedev)	Study of methanol masers.
M434	Marston, A. (Drake U.) Appleton, P. (Iowa State) Norris, R. (CSIRO) Heisler, C. (Mt. Stromlo) Dopita, M. (Mt. Stromlo)	Study of molecular gas associated with compact objects in low-powered AGNs (COLAs) – Part II.
M438	Magnani, L. (Georgia) LaRosa, T. (Kennesaw State) Shore, S. (Indiana)	^{13}CO observations of MBM 40.
P184	Pagani, L. (Paris Obs) Pardo, J-R. (Caltech)	Study of the physical structure of L134N.

No.	Observer(s)	Title
S447	Sandor, B. (High Altitude Obs) Clancy, R. T. (SSI, Boulder)	Earth atmosphere studies.
S450	Strelnitski, V. (Maria Mitchell Obs.) Gordon, M. Jisonna, L. (Arizona)	Monitoring of MWC 349 in H30α and H35α recombination lines.
S452	Smith, B. J. (East Tennessee State) Struck, C. (Iowa State)	Study of molecular gas and star formation in extragalactic tails and bridges.
S453	Su, Y. (SA/IAA, Taiwan) Lim, J. (SA/IAA, Taiwan) Zhang, Q. (CfA) Ho, P. T. (CfA)	Study of bipolar molecular outflows from high-mass protostars.
S454	Su, Y. (SA/IAA, Taiwan) Lim, J. (SA/IAA, Taiwan) Ho, P. T. (CfA)	Study of molecular cores and outflows around nascent/very young massive stars.
S456	Sandor, B. (High Altitude Obs) Clancy, R. T. (SSI, Boulder)	Study of stratospheric C100C1.
T386	Turner, B.	A search for ethyl formate to test current models of complex molecule formation on dust grains.
T387	Turner, B.	Study of deuterium in translucent clouds.
T388	Turner, B. Kaiser, R. (SA/IAA, Taiwan)	A search for C_3D isomers as a test of interstellar hydrocarbon chemistry.
W391	Wolf-Chase, G. (Chicago) Barsony, M. (Harvey Mudd College) O'Linger, J. (JPL)	Outflow observations of a new protostar in L1448.
W422	Wang, D. (Massachusetts) Heyer, M. (Massachusetts) Williams, J. (Florida)	The CO to H_2 conversion factor from X-ray absorption or putting the X into the X factor.
W425	Womack, M. (St. Cloud State U.)	The search for chemical diversity in comets.
W427	Woodney, L. (Maryland) Hearn, M. (Maryland) McMullin, J.	Study of parent molecules in Comet Linear (1999 S4).
Z175	Ziurys, L. (Arizona) Savage, C. (Arizona) Highberger, J. (Arizona)	A search for interstellar and circumstellar KH.

No.	Observer(s)	Title
Z176	Ziurys, L. (Arizona) Savage, C. (Arizona) Highberger, J. (Arizona)	IRC+10216 is not unique: searches for metal-bearing species towards other late-type stars.
Z177	Ziurys, L. (Arizona) Savage, C. (Arizona) Highberger, J. (Arizona)	Ion chemistry in photon-dominated regions II: establishing the $HCO^+/HOC^+/CO^+$ chemical network.

N. PERSONNEL

New Hires

King, David	Scientific Prog. Analyst	6/19/00

Terminations

Field, Samuel	Junior Engineering Associate	5/19/00
Folkers, Tom	Electronics Engineer	4/28/00
Lively, Richard	Sci. Progr. Analyst	6/30/00
Martinez, Ricardo	Systems Analyst	4/04/00
Sandell, Goran	Visiting Assistant Scientist	6/30/00

Promotions

Balser, Dana	to Associate Scientist-Green Bank Ops	7/01/00
Beverage, Charles	to Management Info System Manager	5/01/00
Bolyard, Jody	to Safety & Env. Protection Manager	5/01/00
Butler, Bryan	to Associate Scientist-Research Support	7/01/00
Carilli, Christopher	to Scientist-Socorro Ops	7/01/00
Cornwell, Timothy	to Sci(T)-Associate Director/Data Mgmt	5/01/00
Glendenning, Brian	to Scientist/Head Computing-ALMA	7/01/00
Hunt, Gareth	to Sci(C)-Deputy Assistant Director	7/01/00
Kembal, Athol	to Scientist-Deputy Asst Director/Data Mgmt	7/01/00
McKinnon, Mark	to Scientist-Dep Asst Dir/Green Bank Ops	7/01/00
McMullin, Joseph	to Scientist	7/01/00
Moellenbrock, George	to Assistant Scientist	5/25/00
Radford, Simon	to Scientist-Research Support	7/01/00

Status Change

Bastian, Tim	Scientist-Return from LOA	5/19/00

O. PUBLICATIONS

Attached as Appendix A 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, APRIL - JUNE 2000

BECK, S.C.; TURNER, J.L.; KOVO, O. High Resolution Radio Maps of WR Galaxies: Optically Thick H II Regions?

BELL, M.B.; AVERY, L.W.; SEAQUIST, E.R.; VALLEE, J.P. A New Technique for Measuring Impact-Broadened Radio Recombination Lines in H II Regions: Confrontation with Theory at High Principal Quantum Numbers.

BIGGS, A.; XANTHOPOULOS, E.; BROWNE, I.W.A.; KOOPMANS, L.; FASSNACHT, C.D. VLA 8.4GHz Monitoring Observations of the CLASS Gravitational Lens B1933+503.

DE PREE, C.G.; WILNER, D.J.; GOSS, W.M.; WELCH, W.J.; MCGRATH, E. Ultracompact H II Regions in W49N at 500 AU Scales: Shells, Winds and the Water Maser Source.

DHAWAN, V.; GOSS, W.M.; RODRIGUEZ, L.F. Small-Scale Structure in Galactic H I Absorption towards GRS 1915+105.

DOUGHERTY, S.M.; WILLIAMS, P.M.; POLLACCO, D.L. WR 146 - Observing the OB-Type Companion.

EYRES, S.P.S.; BODE, M.F.; O'BRIEN, T.J.; WATSON, S.K.; DAVIS, R.J. The Remnant of Nova Cassiopeiae 1993 (V705 Cassiopeiae)

FRAIL, D.A.; WAXMAN, E.; KULKARNI, S.R. A 450-Day Light Curve of the Radio Afterglow of GRB 970508: Fireball Calorimetry.

HAYNES, M.P.; JORE, K.P.; BARRETT, E.A.; BROEILS, A.H.; MURRAY, B.M. Kinematic Evidence of Minor Mergers in Normal Sa Galaxies: NGC 3626, NGC 3900, NGC 4772 and NGC 5854.

HJELLMING, R.M.; RUPEN, M.P.; HUNSTEAD, R.W.; CAMPBELL-WILSON, D.; MIODUSZEWSKI, A.J.; GAENSLER, B.M.; SMITH, D.A.; SAULT, R.J.; FENDER, R.P.; SPENCER, R.E.; DE LA FORCE, C.J.; RICHARDS, A.M.S.; GARRINGTON, S.T.; TRUSHKIN, S.A.; GHIGO, F.D.; WALTMAN, E.B.; MCCULLOUGH, M. Radio and X-ray Observations of the 1998 Outburst of the Recurrent X-ray Transient 4U 1630-47.

HUARD, T.L.; WEINTRAUB, D.A.; SANDELL, G. Submillimeter Maps of Small Young Clusters in Three Large Globules.

IMAI, H.; KAMEYA, O.; SASAO, T.; MIYOSHI, M.; DEGUCHI, S.; HORIUCHI, S.; ASAKI, Y. Kinematics and Distance of Water Masers in W3 IRS5.

KNEE, L.B.G.; SANDELL, G. The Molecular Outflows in NGC 1333.

KORNREICH, D.A.; HAYNES, M.P.; LOVELACE, R.V.E.; VAN ZEE, L. Departures from Axisymmetric Morphology and Dynamics in Spiral Galaxies.

LISTER, M.L.; SMITH, P.S. Intrinsic Differences in the Inner Jets of High- and Low-Optically Polarized Radio Quasars.

LUCAS, R.; LISZT, H.S. Comparative Chemistry of Diffuse Clouds. I. C2H and C3H2.

MATTHEWS, L.D. The Extraordinary 'Superthin' Galaxy UGC 7321. II. The Vertical Disk Structure.

NEFF, S.G.; ULVESTAD, J.S. VLA Observations of the Nearby Merger NGC 4038/4039: H II Regions and Supernova Remnants in 'The Antennae'

SAHAI, R.; NYMAN, L.-A.; WOOTTEN, A. He2-113: A Multipolar Planetary Nebula with Rings around a Cool Wolf-Rayet Star.

SMITH, B.J. Interstellar Gas in the NGC 4410 Galaxy Group.

TARCHI, A.; NEININGER, N.; GREVE, A.; KLEIN, U.; GARRINGTON, S.T.; MUXLOW, T.W.B.; PEDLAR, A.; GLENDENNING, B.E. Radio Supernovae, Supernova Remnants and HII Regions in NGC 2146 Observed with MERLIN and the VLA.

TAYLOR, G.B.; BLOOM, J.S.; FRAIL, D.A.; KULKARNI, S.R.; DJORGOVSKI, S.G.; JACOBY, B.A. The Rapidly Fading Afterglow from the Gamma-Ray Burst of 1999 May 6.

TAYLOR, G.B.; MARR, J.M.; PEARSON, T.J.; READHEAD, A.C.S. Kinematic Age Estimates for 4 Compact Symmetric Objects from the Pearson-Readhead Survey.

PREPRINTS RECEIVED, APRIL - JUNE 2000

VAN LANGEVELDE, H.J.; VLEMMINGS, W.; DIAMOND, P.J.; BAUDRY, A.; BEASLEY, A.J. VLBI Astrometry of the Stellar Image of U Herculis, Amplified by the 1667 OH Maser.

VERHEIJEN, M.; TRENTHAM, N.; TULLY, B.; ZWAAN, M. The HI Mass Function in Ursa Major.

WHITE, S.D. Implementation of a Photonic Automatic Gain Control System for Correcting Gain Variations in the Green Bank Telescope Fiber Optic System.

WHITE, S.M.; THOMAS, R.J.; BROSIUS, J.W.; KUNDU, M.R. The Absolute Abundance of Iron in the Solar Corona.

WILLIAMS, J.P.; MYERS, P.C. Evidence for Pressure Driven Flows and Turbulent Dissipation in the Serpens NW Cluster.

WILNER, D.J.; HO, P.T.P.; KASTNER, J.H.; RODRIGUEZ, L.F. VLA Imaging of the Disk Surrounding the Nearby Young Star TW Hya.

WILSON, T.L.; GAUME, R.A.; GENSHEIMER, P.; JOHNSTON, K.J. Kinematics, Kinetic Temperatures and Column Densities of NH3 in the Orion Hot Core.

WOLF-CHASE, G.A.; BARSONY, M.; O'LINGER, J. Giant Molecular Outflows Powered by Protostars in L1448.

YOUNG OWL, R.C.; MEIXNER, M.M.; WOLFIRE, M.; TIELENS, A.G.G.M.; TAUBER, J. HCN and HCO+ Images of the Orion Bar Photodissociation Region.