NATIONAL RADIO ASTRONOMY OBSERVATORY

Quarterly Report

July – September 2004

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Executive Summary

ALMA

Adrian Russell, currently the Director of the U.K. Astronomy Technology Centre, has been recruited as the new North American ALMA Project Manager and will officially begin his duties in January 2005. NRAO Director K.Y. Lo will continue as interim North American ALMA Project Manager until Russell arrives.

Considerable progress has been made toward executing a production antenna contract. Negotiations with the selected contractor, the European Southern Observatory (ESO), and the Joint ALMA Office (JAO) continue, and a contract is anticipated during the first quarter of FY 2005. To accommodate an anticipated ALMA Project re-baseline in FY 2005, the contract will provide for a range of antenna quantities.

A contractor has been selected for the initial construction of the ALMA Array Operation Site (AOS) technical building. Office facilities for the JAO and Executive staff have been leased in Santiago and will be ready for occupancy by the end of October 2004.

The first front-end cryostat was delivered to the NRAO Technology Center (NTC) in Charlottesville from the Rutherford Appleton Lab and will be integrated into a front-end chassis and outfitted with bias, monitor and control, and other support electronics at the Front End Integration Center.

The Correlator Room at the NTC has been completed and all first-quadrant racks are ready for hardware installation. All major procurements for components and commercial fabrication have been placed. Production of the custom Correlator chips has been completed, and fully tested chips have been delivered for all four quadrants.

Prototype systems integration (PSI) has begun at Tucson and Socorro. At the conclusion of the PSI lab phase, the hardware will be installed on the two prototype antennas at the Antenna Test Facility for an end-to-end test, demonstrating astronomical fringes prior to integration in Chile.

The North American ALMA Science Center (NAASC) began preparing an operations plan that includes staffing levels and budget estimates for FY 2005 – 2012. NAASC staff have also reviewed the draft ALMA Operations Plan being prepared by the JAO and initiated planning for future events highlighting ALMA and the NAASC, such as the ALMA Town Meeting at the January 2005 American Astronomical Society meeting. Work has begun to improve ALMA information access via the NRAO website, and NAASC staff are been engaged in testing ALMA software, such as the Observe Tool which will be used to submit proposals.

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EVLA

Structural modifications of the second EVLA antenna have been completed and installation of EVLA electronic systems has commenced. A prototype of the new C-Band feed has been constructed and tested, and the prototype C-Band cryogenic receiver has been successfully cooled for the first time. The Canadian Partners have completed their evaluation of initial correlator-chip bids and have found that there are three viable vendors. The first of a large number of production-quantity purchases of critical electronic and mechanical components have been placed.

Green Bank Telescope

The NRAO has made good progress on projects and operations at the Robert C. Byrd Green Bank Telescope (GBT) this quarter. Investigations and trials conducted to provide technical resolution of the azimuth track issues, for example, are proceeding well. A trial splice-plate experiment and a trial of an alternative wear-plate material with better fatigue resistance have both yielded good results. Finite-element analyses conducted by an external contractor and by NRAO engineering staff have yielded valuable results. An engineering review is being organized.

GBT structural inspections were completed this quarter. Overall, the structure is in very good condition, though some weld repairs and water ingress locations required attention and are being addressed.

The Ka-Band (26-40 GHz) receiver and ancillary instrumentation were installed this quarter. This receiver will bring significant new scientific capability to the GBT, particularly for high-redshift molecular line detection and for the correction of point-source contamination of cosmic background fields. The microwave group worked this quarter to improve the stability, calibration, and spectral baselines of the Q-Band receiver.

The Precision Telescope Control System (PTCS) project derived new pointing models that compensate for azimuth and elevation residuals, and analysis and observing techniques were refined for characterizing the large-scale surface of the GBT dish.

The Software Development Group issued two new releases of the Monitor and Control (M&C) System, and a beta release of a new Observing Application Programming interface. The IDL data-reduction project, which will provide a system for interactive analysis of spectral line and continuum data, was initiated this quarter.

The Radio Frequency Interference (RFI) group continued its efforts to reduce RFI on-site and in the surrounding community, which has enabled some important science results at low frequencies.

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Very Large Array & Very Long Baseline Array

Scientific observations with the VLA-Pie Town link entered their fourth operational A-configuration just at the end of the third quarter. This is the first autumn/winter session for the Pie Town link since the new 43 GHz and improved 22 GHz receivers have been completed.

The multi-year project to upgrade the VLA encoders has been completed. Tests show that periodic pointing errors have been reduced well below the 6 arcsecond level, thus enabling the VLA to achieve pointing stability better than one-tenth of a beamwidth at 43 GHz.

The on-line archive of VLA and VLBA data has reached the end of its first year. More than 550 users from 240 institutions have downloaded data from this archive. The number of users is somewhat greater than the 400 observers who gathered new data with the VLBA during calendar year 2003, and somewhat fewer than the 847 different observers who used the VLA in 2003. Coincidentally, the 240 institutions represented is equal to the total that had individuals use the VLA, VLBA, or GBT during 2003.

We now have completed a year of scientific observing since the new NRAO "Rapid Response Science" policies were put into effect. A total of 21 exploratory and target-of-opportunity proposals have been accepted on the VLA and six on the VLBA. The importance of the new rapid-response mechanisms was shown at the end of September and the beginning of October, when the VLA responded to a HETE gamma-ray burst, a soft gamma-ray repeater, a Galactic Center transient, and the supernova in NGC 6946, some with multiple observations, all within a period of ten days. Observations of (at least) the NGC 6946 supernova and one or two others of these transients are expected to continue during the fourth quarter.

The last regular VLBA maintenance visit of the year was being completed with a visit to Owens Valley at the end of September. Four VLBA antennas were visited during 2004. New digital tachometers now have been installed on half the VLBA stations, reducing maintenance costs and improving antenna reliability.

During the maintenance visit to the Brewster VLBA station in August, a newly refurbished subreflector was installed and aligned. Tests show that the overall aperture efficiency of Brewster at 43 GHz was improved from 30 to 50 percent by the replacement of the poorly performing subreflector. The old subreflector has been returned to the VLA site and will be measured in the lab to determine whether it can be resurfaced usefully.

Five VLBA stations and the GBT now have Mark 5 disk-based recording systems installed. In August these systems were used to support the first test for the Huygens Probe tracking experiment, which is planned to take place in January 2005. The VLBA correlator now contains Mark 5 playback drives for three stations, and enough disks have been procured to operate Pie Town, Kitt Peak, and Los

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Alamos as full-time Mark 5 stations. Although those stations could operate as Mark 5 stations now, we have delayed the final transition and "turning off" the old tape drives until the fourth quarter, after additional operational experience has been gained.

Central Development Laboratory

Development of new low-noise amplifiers for the EVLA continues with good success, and amplifier production is keeping up with EVLA needs. The ALMA Band 6 receiver cartridge production serial #1 was completed. The ALMA local-oscillator chains are meeting the requirements for phase noise, phase drift, sideband noise, and power output for Bands 3, 6, and 7; power output is low for Band 9. Design of a new 385-500 MHz SIS mixer is complete, and HEB mixers for 600-720 GHz were successfully tested. The ALMA correlator team made excellent progress toward producing the first quadrant on schedule and under budget. The design of new feed systems for the EVLA and VLBA has produced prototypes showing excellent agreement with calculations and meeting the performance requirements. The first phase of the Green Bank Solar Radio Burst Spectrometer continues in regular operation for 20-70 MHz, and design work for the intended 10-3000 MHz range is making good progress.

Computing and Information Services

During this quarter the NRAO Computing Security Committee collaborated with their counterparts at the European Southern Observatory (ESO) to explore and resolve the issues of computer and network security for the ALMA project. The security section of an operations plan for ALMA was drafted. As a result of focused attention on security by CIS personnel, the NRAO continues to be almost entirely spared from major virus outbreaks. Improved user education has also contributed to this success.

The Common Computing Environment (CCE) group has decided on the path forward for Linux computer support, adopting RedHat Enterprise Linux.

The second NRAO public wiki or web-based collaborative platform was made available this quarter. Unlike the original NRAO wiki, which was restricted to use by systems on the Observatory's Intranet, this wiki is accessible from anywhere on the Internet. Significant collaboration is already occurring on this platform between NRAO staff and personnel at external institutions, such as the European Southern Observatory (ESO).

A "Beowulf" cluster of powerful, rack-mounted Linux servers has been bid to satisfy the requirements of Charlottesville scientific staff for pulsar data reduction. This is the first such cluster (eight processors plus a master node) that will be operated by the Observatory.

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Improvements to the Observatory's computing environment funded by CIS this quarter included a new file server in Green Bank, a new Mac OS/X processing computer in Charlottesville, and new servers for the VLA site and the Green Bank Science Center.

The work required to build the phone and network infrastructure within the Observatory's new Edgemont Road (Stone Hall) facilities in Charlottesville commenced this quarter and will continue through next quarter as these facilities are occupied by the NRAO in January 2005.

As a result of lower costs for our Intranet contract with AT&T, funds have become available to upgrade service at four VLBA sites and an upgrade to T1 (1.544 Mbps) access has been completed at Hancock and Owens Valley.

A concerted effort was made to migrate staff at the NRAO Technology Center (NTC) to Windows XP and enter them into the Active Directory (AD) domain. This work has been successfully completed and has already eased the burden on the Observatory's Charlottesville Windows support staff.

Education and Public Outreach

During this quarter, the EPO staff initiated two new programs in response to recommendations made by the NRAO/AUI Visiting Committee: the Legacy Imagery Project and the Science Museum Outreach. The Legacy Imagery Project will develop in-house capability to process astronomical data acquired at radio wavelengths into visually compelling imagery. The new Science Museum Outreach efforts will bring the NRAO science and outreach to major museums in the United States. The EPO staff is working with their colleagues at the Space Telescope Science Institute (STScI), crafting mutually beneficial collaboration between the NRAO and the STScI to enable these programs. The staff also wrote and distributed several interesting press releases about important radio astronomy scientific research results. Attendance and revenue at the Green Bank Science Center and VLA Visitors Center continued to increase, marking substantial improvements over the same quarter last year. Progress continued on plans for a new visitor's center at the VLA. An exciting, large regional star party sponsored by the Central Appalachian Astronomy Club was hosted in Green Bank, drawing amateur astronomers from across the Midwest and the East. In Socorro, the inaugural *Radio Astronomy for Teachers* course was offered through New Mexico Tech's Master of Science Teaching program. This two-week radio astronomy class for teachers was a direct outgrowth of the NRAO teacher workshop *"Doing Dishes"* funded by a NASA IDEAS grant. During this quarter more than 30 NRAO employees participated in more than 60 EPO activities

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Environment, Safety, and Security

ES&S participated in several reviews for the ALMA project including one on fire protection for the correlator to be installed at the Array Operations Site in Chile. During this quarter, extensive work was performed on the NRAO-wide laser safety program to provide guidance for the safe use of both fiber and free-space lasers. The final safety-program requirements for the use of the Jackson 7000 rail tamper at the VLA were met this quarter. At Green Bank, the annual sprinkler inspection was conducted to test the site life/fire safety measures. At Green Bank and Charlottesville, training programs for the use of Automated External Defibrillators (AED) were initiated.

Science Highlights

Very Large Array

VLA Helps Confirm New Class of Gamma Ray Burst - Multiple flux measurements and radio light curves made with the VLA were an essential element leading to the conclusion that Gamma Ray Burst (GRB) 031203 was an intrinsically sub-energetic event compared to "classic" GRBs. Multi-wavelength studies of the afterglow suggest that GRB 031203 is an analog to GRB 980425, which was associated with supernova 1998bw. This discovery implies the existence of a new class of low-energy GRBs, most of which remain below current detection limits.

Investigators: A. M. Soderberg, S. R. Kulkarni, E. Berger, and D. W. Fox (Caltech); M. Sako (Stanford); D. Frail (NRAO); A. Gal-Yam (Caltech); D. S. Moon, S. B. Cenko, and S. A. Yost (Space Radiation Laboratory, Caltech); M. M. Phillips, S.E. Persson, W. L. Freedman, and P. Wyatt (Carnegie Observatories); R. Jayawardhana and D. Poulson (U. Michigan).

Very Long Baseline Array

Moving Microquasar Linked to Natal Star Cluster - Using data from numerous observations with the VLBA and other telescopes, researchers have measured the proper motion of a microquasar and concluded that it was propelled out of a nearby star cluster by an asymmetric supernova explosion about a million years ago. The microquasar LSI +61 303 is moving away from a star cluster named IC 1805 at more than 25 kilometers per second, and the companion to the compact object in the microquasar shares the spectral characteristics of the cluster population. This is the first time that a binary pair has been traced to a specific natal star cluster. The microquasar, containing a compact object of about 2 solar masses and a companion of 14 solar masses, is about 130 light-years distant from the cluster.

Investigators: I. F. Mirabel (CEA Saclay); I. Rodriguez (CEA Saclay and Univ. Federal do Rio Grande do Sul, Brazil); and Q. Z. Liu (CEA Saclay and Purple Mountain Observatory, China).

Green Bank

Multiple Pulsar Detections in the Globular Cluster Terzan 5 - A single six-hour observation in July 2004 using the GBT at 2 GHz resulted in the discovery of 14 new pulsars in the rich globular cluster Terzan 5. Follow-up observations in October resulted in the discovery of at least three additional pulsars. Terzan 5, which is located near the Galactic Center, has long been suspected of harboring many millisecond pulsars (MSPs) because of its large predicted stellar interaction rate and the steep-spectrum radio emission observed in its core. However, earlier pulsar searches using the Parkes radio telescope only uncovered three pulsars. These new GBT discoveries confirm that Terzan 5 is one of the largest producers of MSPs among the Galactic globular clusters and imply that the 20+ known pulsars are but the tip of the iceberg. At least nine of the new pulsars are members of binaries. Among these new pulsars there are also two or more eclipsing systems, the third- and fourth-fastest known rotators, a rare long-

orbital-period binary, and two highly eccentric systems. Timing of the eccentric binaries over the next year will provide their total masses and may (after several years) allow separation of the pulsar and companion masses. Timing observations of the ensemble of pulsars will probe stellar and binary evolutionary scenarios, the mass-to-light ratio of the cluster core (and provide evidence for or against a black hole residing there), and other aspects of globular-cluster dynamics.

Investigators: S. M. Ransom (NRAO), J. W. T. Hessels (McGill), I. H. Stairs (UBC), P. C. Freire, (NAIC), V. M. Kaspi (McGill), F. Camilo (Columbia), D. L. Kaplan (Caltech/MIT).

Cold Sugar Molecules near the Galactic Center - Investigators have used the GBT to detect a very cold interstellar cloud containing the simple sugar molecule glycolaldehyde (CH2OHCHO) in the Sgr B2 region. Four high signal-to-noise transitions were detected between 13 and 22 GHz. The data included both emission and absorption features. An analysis of the data indicated that the cloud is at a temperature of only ~8 K. These data, together with other information on the region, suggest that the sugar molecules were formed on the surface of grains, then released into the gas phase through disruption of the grain mantles by passing shock waves. The observed molecules now exist in the cold post-shock region. The GBT proved very powerful in these observations owing to its frequency agility, wide spectral bandwidths, and small beam which coupled very efficiently to background continuum sources allowing the detection of the absorption lines.

Investigators: J. M. Hollis (NASA-GSFC), P. R. Jewell (NRAO), F. J. Lovas (NIST), and A. Remijan (NASA-GSFC)

ALMA

The North American Project Office is being reorganized and expanded. Adrian Russell, currently Director of the U.K. Astronomy Technology Centre, has been recruited as the new North American Project Manager. He will officially begin his duties in early January 2005. Marc Rafal, who was previously the Project Manager, has assumed the new position of Deputy Project Manager. Fred K. Y. Lo has assumed the position of Interim Project Manager until Russell's arrival.

Richard Simon, who had previously held the position of Controller for the North American Project Office, has assumed the Controller position within the Joint ALMA Office (JAO). David Hubbard, the NRAO Program Office Head, has been appointed Interim Controller while a permanent Controller is recruited. The Controller position will be reorganized under the North American ALMA Business Manager, William Porter. Additional project coordinator positions have been created within the project office to assist the North American IPT leads collect, analyze, and report status information using the PMCS system.

A contractor has been selected for the initial construction of the ALMA Array Operations Site (AOS) technical building. The foundation package includes the necessary excavation and the construction of the building foundation. Work will start as soon as NSF approval is received for the contract. Outfitting of the temporary ALMA office has been started in leased space in Santiago, Chile. The office will house the JAO and Executive staff located in Santiago. The office facilities will be ready for occupancy at the end of October 2004.

Progress has been made toward executing a production antenna contract. Negotiations with the selected contractor as well as the European Southern Observatory (ESO) and the JAO continue. A contract is anticipated during the first quarter of FY2005. The contract will provide options for a range of quantities of antennas to accommodate an anticipated re-baselining of the project in FY2005.

The first front-end cryostat was delivered to the NRAO Technology Center (NTC) in Charlottesville from the Rutherford Appleton Lab. This cryostat will be integrated into a front-end chassis and outfitted with bias, monitor and control, and other support electronics at the Front End Integration Center over the coming months. Band 3, 6, 7, and 9 cartridges will be delivered beginning in the first quarter of FY2005 and will be integrated and tested.

The first quadrant of the Correlator is progressing very well. The Correlator Room at the NTC has been completed, and all racks for the first quadrant are ready for installation of hardware. All major procurements for components and commercial fabrication have been placed. Production of the custom Correlator chips has been completed and fully tested chips have been delivered for all four quadrants. Eighty-four percent of printed circuit boards required for the first quadrant have been fabricated, populated with all components, and delivered.

ALMA

Prototype systems integration (PSI) has begun at Tucson and Socorro. PSI starts with a lab integration of prototype modules and software to verify the end-to-end functionality of the ALMA configuration. PSI includes sufficient hardware to support signal flow from two antennas through the prototype Correlator. At the conclusion of the lab phase, the hardware will be installed on the two prototype antennas at the Antenna Test Facility (ATF) allowing an end-to-end system test, demonstrating astronomical fringes prior to integration in Chile.

The following tables provide summary milestone progress, financial, and staffing information for the ALMA Project as of the end of the reporting period. Table 1 shows the planned versus completed milestones. In addition to the actual milestone completions, the fractional completion of incomplete milestones is tabulated in the *Work in Progress* column. When added to the completed milestones, this provides a more accurate picture of the total amount of progress that has been made to date. This is shown in the column labeled *Total Effective Milestone Completions*.

Table 1: Progress Against Milestone Plans

IPT	Planned Milestone Completions	Actual Milestone Completions	Work In Progress On Incomplete Milestones	Total Effective Milestone Completions
Site	12	6	2.5	8.5
Antenna	7	6	0.9	6.9
Front End	18	7	4.1	11.1
Back End	2	0	1.2	1.2
Correlator	10	9	0.8	9.8
Computing	11	11	0	11
Systems Engineering	11	5	3.6	8.6
Science	8	7	0.9	7.9
Total	**79**	**51**	**14**	**65 82% of planned completions**

Table 2: ALMA Project Expenditures and Commitments

WBS	FY2004				Project to Date		
	Budget Plan	Actual This Period	Actual Last Period	FY2004 To Date	Project Budget	Project To Date This Period	Project To Date Last Period
	$K	$K	$K	$K	$K	$K	$K
1. Management	2,666	127	100	3,027	20,582	4,604	4,478
2. Site	4,561	28	17	375	27,162	1,123	1,094
3. Antenna	750	106	30	347	123,489	1,497	1,391
4. Front End	6,528	586	312	5,085	37,751	12,408	11,822
5. Back End	3,984	214	203	2,911	37,948	6,817	6,603
6. Correlator	4,897	409	53	4,853	9,168	5,925	5,517
7. Computing	1,888	172	171	1,927	15,767	4,117	3,945
8. Systems	1,550	67	114	1,015	11,601	2,814	2,747
9. Science	548	37	77	482	4,665	1,017	979
Shared Admin	2,839	339	398	4,545	19,916	8,225	7,886
Not yet allocated	0	-16	5	444	0	37	53
Totals	30,210	2,069	1,479	25,011	308,049	48,583	46,515

Table 3: ALMA Staffing

WBS Task Name	Planned Staff (Oct '02 Plan)	Actual Full-time Equivalent Employees
Management (includes NA Project Office staff and NA share of JAO staff)	5.3	3.7
Site Development	4.6	1.9
Antennas	4.7	3.0
Front End	49.5	27.6 + 12 Canadian
Back End	20.7	19.0
Correlator	9.2	4.8
Computing	17.7	18.9
System Integration	12.9	7.4
Calibration	4.6	3.3
Shared Admin Functions	NA	12.2
TOTAL:		**101.8 + 12 Canadian**

The shared administrative staff are broken down by location and function as follows:

Charlottesville	
Business Manager	1.0
Accountant	1.0
Buyer	1.0
Secretary	1.5
Socorro	
Secretary	1.0
IT Support	0.3
Tucson	
Secretary	1.0
Business Manager	1.0
IT Support	0.9
Santiago	
Business Manager	0.5
Accountant	1.0
Gov. Liaison	1.0
Secretary	1.0

ALMA

Activities of the North American ALMA Science Center (NAASC)

During this quarter NAASC staff primarily engaged in organizational and planning activities. These include: beginning the preparation of an NAASC operations plan with staffing levels and budget estimates for the FY2005 – 12; assignment of space to various NAASC functions in the new quarters under construction; review of drafts of the ALMA Operations Plan being prepared by the Joint ALMA Office; and making preparations for future events where ALMA is to be highlighted.

The largest of these events will be a Town Meeting to be held during the San Diego meeting of the American Astronomical Society this coming January. Content for an ALMA display, brochures, and a handout directed to potential users was developed. The agenda for the meeting was drawn up together with the ALMA North American Scientific Advisory Committee (ANASAC). This display was used at a one-day symposium organized by the AAS and Chilean Embassy to highlight U.S.—Chile cooperation in astronomy. Talks were given at the symposium by the NRAO staff. The workshop held last quarter at the University of Maryland to review the plans for early ALMA science was reviewed to better plan future events.

Work has begun to improve the access to information on ALMA via the NRAO website. A web page has been established for the NAASC with links to the ANASAC and other web pages having ALMA content. The intent is to work out through the various pages, improving the design and making it easier to reach current information.

NAASC staff have been engaged in testing ALMA software, particularly, the Observe Tool which will be used to submit proposals and data analysis software (AIPS++). In addition, work has begun on spectral-line and calibration-source databases.

Regularly scheduled meetings included bi-monthly meetings of the ANASAC and bi-weekly meetings of the NAASC staff. P. Vanden Bout gave two presentations: one to the NRAO scientific staff and a second to a broader audience of Charlottesville (NRAO and UVa) astronomers and NRAO employees. He presented a condensed version of this talk to the ALMA Science Advisory Committee. The goals and structure of the NAASC were set out in these talks with expected schedules for accomplishing major milestones.

Goals for the next quarter: We will make final the plans for the Town Meeting in San Diego. A top goal is to translate the budget in the ALMA Operations Plan (draft II) into a cost for the NSF that includes all elements of the NAASC not funded as a regional ALMA center in that Plan, and compute the cost to Canada as well. This will be followed by a careful inspection of the elements of the Plan to assess that requirements are met but not exceeded. We will continue work on the website and software testing. We will also conduct a study to determine the requirements for a program of data-analysis support grants for U. S. ALMA users. We will prepare for the move into new quarters anticipated at the end of 2004 or early 2005.

Expanded Very Large Array

Expanded Very Large Array (EVLA) Highlights

Structural modifications of the second EVLA antenna has been completed and installation of EVLA electronic systems has commenced. A prototype of the new C-Band feed has been constructed and tested, and the prototype C-Band cryogenic receiver has been successfully cooled for the first time. The Canadian Partners have completed their evaluation of initial correlator-chip bids and have found that there are 3 viable vendors. The first of a large number of production-quantity purchases of critical electronic and mechanical components have been placed.

Expanded Very Large Array Milestones

Milestones	Original Date	Revised Date	Date Completed
Replace fiber watch spring on Antenna 13	07/16/04		07/16/04
Antenna 13 ready for test science	07/16/04		07/16/04
Move Fiber Lab to CB annex	08/13/04		07/16/04
2nd base band converter w/MIB connected in Antenna 13	07/20/04		07/20/04
2 controllable IF's in Antenna 13	07/30/04		07/30/04
2nd L352 RTP module and ICD ready for MIB software	08/09/04		08/09/04
8 GHz feed horn design complete	08/09/04		08/09/04
Assemble new DTS bin for FE rack placement	08/17/04		08/17/04
Redesign and assemble MCB-rack	08/19/04		08/19/04
3 GHz feed tested	05/14/04	08/13/04	08/23/04
Move Antenna 13 to array	08/05/04		08/25/04
Install C-Band feed on Antenna 14	08/31/04		09/15/04
FY2005 budget plan	09/16/04		09/16/04
Network slot ID installed on Antenna 13	08/16/04		09/21/04
LO/FE Racks installed on Antenna 14	08/16/04		09/21/04
L-Band feed single dish testing	09/21/04		09/21/04
U/X converter ready for test Antenna	11/14/03	07/12/04	09/21/04
Network slot ID install on Antenna 13 ACU/FR interface	09/29/04		09/29/04
K & Q-Band receivers usable - Antenna 13	07/22/04		09/30/04
Cold storage building erected	06/18/04	08/30/04	09/30/04
ACU/FR MIB interface installed on Antenna 14	10/04/04		
1.5 GHz feed horn installed on Antenna 14	10/05/04		

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
Bench integration test racks populated	05/07/04	10/05/04	
Move 2nd test antenna (14) to array	09/27/04	10/06/04	
Start 1st production antenna overhaul	09/30/04	10/06/04	
8 and 22 GHz receiver installed on Antenna 14	10/07/04		
FE card cage prototype assembled	10/07/04		
M301 converter interface module ready for software	10/07/04		
Software requirements for real-time system	08/29/03	10/11/04	
Install MCB rack in Antenna 14	10/12/04		
75/328 MHz converter module ready for test antenna	10/24/03	10/13/04	
1st draft of correlator shielded room specifications	10/14/04		
2nd F320 module assembled and tested	07/21/04	10/15/04	
Power supply board (P301 & P302) assembled & tested	07/30/04	10/15/04	
F320 FE transition module w/MIB & ICD ready for software	12/09/04	10/15/04	
Fabricate NRAO Q-Band MMIC post amplifier	07/16/04	10/18/04	
First fringes on Antenna 14	09/09/04	10/18/04	
2nd L353 LO transmitter module w/MIB assembled	10/19/04		
Monitor &Control CDR	09/15/04	10/20/04	
Complete Part 1 hardware bench integration	03/03/03	10/21/04	
LO/IF switches ready for test antenna	05/06/04	10/21/04	
Two F317 modules w/ MIB tested and ready for antenna	09/08/04	10/21/04	
MIB control band select switches on Antenna 13	10/21/04		
F317 FE interface prototype assembled	10/26/04		
Multi frequency observing - L & X	07/21/04	10/26/04	
Check for interference and bandpass shapes: 328MHz, 22 & 45 GHz	03/15/04	10/28/04	
Routine test observing	05/13/04	10/28/04	
Verify linearity of RF designs – receiver to correlator	05/27/04	10/28/04	
Check for interference and bandpass shapes 8, 22 & 45 GHz	12/19/03	10/28/04	
Receiver stability tests: 8, 22 and 45 GHz	12/19/03	10/28/04	
45 GHz receiver installed on Antenna 14	10/28/04		
EVLA M&C software ready for multi antenna testing	10/29/04		
1st DTS module w/ transponder	08/31/04	11/01/04	
3 GHz receiver first cool down	11/05/04		

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
L352 RTP module w/ new firmware ready for test rack	11/10/04		
WBS updates due	11/12/04		
Cold storage building ready for inventory	11/15/04		
Feed horns CDR	11/18/04		
Level 2 schedule updates due	12/06/04		
Project Advisory Committee meeting	12/14/04		
MIB control band select switches on Antenna 14	12/15/04		
Correlator shielded room specifications complete	12/15/04		
P, L, X, K & Q-Band receivers usable - Antenna 14	09/13/04	12/15/04	
Install 3 GHz receiver on Antenna 14	12/16/04		
4 IF's on Antenna 14 working	09/13/04	02/15/05	

Management

During this quarter the bi-annual project progress report was prepared and submitted to the NSF, as were the GPRA performance metrics for the project. The FY2005 project plan was developed and distributed to project personnel. A number of large orders for production quantities of critical mechanical and electronic components were processed and committed. Large procurements of this type will continue throughout FY2005 as more of the electronic systems reach the production phase.

A plan to use the Mexican EVLA funds to pay for the electronic modules on the first two EVLA antennas, and for a number of K- and Q-Band receivers, has been accepted by the Mexican CONACyT, although they still require the NRAO to participate in a formal open-bidding process for this work. CONACyT will issue a request for proposal for the work during the next quarter to which NRAO will respond.

Systems Integration

The principal activity in this area continues to be testing and debugging of the prototype electronic systems to qualify them for production. All of the EVLA Test Antenna (Antenna 13) electronics modules were brought back to the Array Operation Center (AOC) and installed in the integration racks in mid-August. This allowed for more thorough testing of the system as well as time to integrate several updated modules, the module ID function, and new cabling. The electronics were installed back in Antenna 13 the week of September 20. This was followed by a few days of final troubleshooting and calibration. The only remaining task is to correct timing problems that were discovered in the L305 module when it was reinstalled in the system.

Expanded Very Large Array

The racks for the second EVLA antenna (Antenna 14) were taken to the site and lifted into the vertex room during the week of September 20. The 48 VDC bulk power supply has been installed in the pedestal room. The electronics modules are currently being set up for final testing in the AOC integration lab. One IF channel at X-Band is expected to be operational in mid-October.

Civil Construction

Design preparation and clearing of the shell space for the new WIDAR Correlator room has started. Remodeling of this space will start after the VLA Modcomp computers, Computer Lab, and other miscellaneous equipment have been relocated to other areas at the VLA Site.

The Fiber Optics Lab was relocated from the VLA Control Building to the VLA Control Building Annex during July 2004. The Computer Lab will be relocated before the end of 2004.

The VLA Modcomp computers will be relocated in February 2005. An existing space in the VLA Operations Area will be remodeled to accept the Modcomp computers. Work on the remodel will begin November 2004.

The erection of the EVLA Storage Building steel was completed in the last week of September 2004. Work to be completed is the installation of a sprinkler system for fire protection and a 120 VAC power supply. The power supply will provide power for a sprinkler-system alarm device, minimal lighting, and power for a roll-up door.

Antenna

Antenna 14 has been outfitted with its feed cone, L, X, C, S, K, Q, and Ka feed towers, and X- and C-Band feed horns. Production quantities of antenna HVAC and feed-cone components were ordered.

Front End

L-Band horn #2 was completed and will be installed on Antenna 14 early in the next quarter. Laminated C-Band horns #1 and #2 were completed and successfully tested on the MIT antenna range. An X-Band feed-horn design and design of an all-aluminum C-Band horn were completed. RFQs were released for production quantities of feed-horn materials. The prototype of the new EVLA C-Band cryogenic receiver was successfully cooled for the first time.

Local Oscillator (LO)

Designs were firmed up for the L304, L350, L351, L353, and L354 modules. The L350 and L353 will require a re-spin of their circuit cards to clean up some layout errors. The L305 and L352 are undergoing some design changes which mostly involve reprogramming internal integrated circuits. The

synthesizers L301 and L302 are waiting for the integrated AGC assembly before the designs can be fixed. These assemblies are due in the first quarter of 2005. The synthesizer designs are working well with the non-integrated hardware but the integrated hardware will save the project about $500K. These synthesizers experienced problems in the early stages due to a combination of hardware and software issues.

Fiber Optics

The new 8-bit digitizer board assembly was completed and initial tests are underway. Testing began on the half-transponder formatter board which is replacing the earlier formatter board that used discrete optical components. The half-transponder replaces all of the discrete optical components with a single RFI-tight module and provides a significant cost saving for the project. The hardware development for the transmitter side was completed including correcting the clocking problems, and the firmware development commenced.

The splicing of the buried fiber along the array arms continued, and additional station pad boxes were placed in the array. The second test antenna (14) fiber cables were spliced in the Pedestal Room, and splicing in the Vertex Room will commence after the Ethernet switch and Front End Rack is installed early in the next quarter. A redesigned fiber watch-spring cable wrap was installed in Antenna 14 and replaced on Antenna 13 after the prototype on Antenna 13 gave problems. Prefab fiber-optic cables were ordered and received for Antennas 14 and 16 and will be installed when racks are in place. Fiber ducting was installed on Antenna 14. The Safety Officer approved an Optical Fiber Communication System (OFCS) Safety plan, and initial training was given to the Electronics Department and everyone at the VLA site.

Intermediate Frequency System

Design of the integrated version of the T304 module neared completion. New requirements were added for the T304 to handle bandpass-flatness issues. The design of a gain equalizer proceeded at the Central Development Laboratory (CDL). These equalizers are to be incorporated in the T304. All three prototype UX converters (T303) were received from the vendor and meet or exceed specifications. Negotiations have been on-going with the vendor for production units. T301 and T302 module designs were completed and are ready for final hardware changes before production begins.

Correlator

The study contracts for the correlator chip were completed, and it now looks like there are at least two, and probably three, vendors that are capable of meeting the design requirements. The Canadian correlator group is now in the process of evaluating these study contracts and, in particular, taking a critical look at reliability of the technologies, the companies involved, and the claims that the companies are making. The results of these investigations are being documented to solicit NRAO's opinion on the

selection of the final chip vendor. A Critical Design Review (CDR) of the correlator chip will be held in the next quarter. Due to advancements in technology, it is now looking very likely that the FIR chip can fit in an FPGA, which can be afforded in terms of both cost and power. This will ease the development and testing requirements for the FIR, since it is possible that a custom or semi-custom design for the FIR chip is not required. In other developments, the design and construction of a test correlator rack to study its mechanical and thermal properties began. The purpose of the test is to be sure that it is possible to adequately deal with the heat generated by the boards, while maintaining cool chip temperatures to maximize reliability and lifetime. As part of this effort, testing a commercially available closed-cycle, liquid-cooled rack to determine its feasibility and cost-effectiveness is planned.

Monitor and Control (M/C)

MIB/module software development has kept pace with module hardware development. MIB systems software (the operating system and network stack) and the generic MIB framework software are showing the levels of robustness and reliability needed. The MIB framework software was successfully ported to the hardware that is used to extract a VLA correlator compatible signal from EVLA antennas - an important transition issue.

The Distributed Objects Communication Team has continued its work, characterizing the communications requirements of core elements of the EVLA monitor and control system. A report of its work, conclusions, and recommendations will be produced in the next quarter.

A draft document describing the software needed to make the transition from a VLA to an EVLA Observing System has been produced. This document is sufficiently detailed with respect to the earlier phases of the transition to serve as a basis for planning and organization. The development of software for Phase I of this plan, whose goal is the incorporation of EVLA antennas into VLA observing, is underway, with a completion date of Q1 2005.

Data Management and Computing

After the successful overall design review held June 14, 2004, work on subsystem design was postponed to 2005 since all necessary resources are needed for Phase I of the transition plan described above.

Green Bank Telescope

Green Bank Telescope Highlights

The Ka-Band (26-40 GHz) receiver was installed on the telescope at the end of the quarter. Following initial engineering tests last spring, the receiver will undergo astronomical commissioning in the fourth quarter and should be released for astronomy in the first quarter of 2005. Project development has kept nicely to schedule over the past year. This receiver has a pseudo-correlation architecture that will allow very sensitive observations in both continuum and spectral-line modes. The science goals of the receiver are the detection of very high redshift CO emission from early galaxies, measurements of continuum point-source contamination in cosmic background fields, and astrochemistry. An ancillary instrument to be used with this receiver, the Caltech Continuum Backend, is under development. A proposal for a wideband spectrometer for high-redshift line detections is also in preparation.

GBT Antenna & Operations

Milestones	Original Date	Revised Date	Date Completed
Complete Phase II of track analysis	10/31/03	08/01/04	8/01/04
Complete Phase III of track analysis	10/31/04		
Complete development of new rail concepts	12/31/03	12/02/04	
Hold panel review meeting	01/31/04	12/07/04	

GBT Electronics

Milestones	Original Date	Revised Date	Date Completed
Spectrometer Upgrades			
Cross-correlation/poln. test fixture designed	01/01/04	10/01/04	
Cross-correlation/poln. test fixture constructed	03/01/04	11/01/04	
Begin polarization mode checkouts	06/01/04	11/15/04	
LTA redesign (engineering only)	04/01/04	10/01/04	
RFI Improvements			
Finish GBT receiver room HVAC suppression	12/01/03	On Hold	

GBT Mechanical Engineering & Central Shop

Milestones	Original Date	Revised Date	Date Completed
ALMA LO Frame Assemblies(8)	07/30/04		07/06/04
GBT RFI Antenna Mount Design	10/29/04		
Test Building Receiver Handler	10/15/04		
Penn Array Electronics Crate	11/05/04		
Penn Array HDPE Lenses	11/05/04		

GBT Software & Computing

Milestones	Original Date	Revised Date	Date Completed
Deprecate IARDS	03/31/04	02/15/05	
First Scheduling Block Executed	03/31/04	07/09/04	07/09/04
Complete GBT High-Level e2e Models	06/30/04	07/31/04	08/26/04
Complete Linux Migration	06/30/05		

GBT Projects

Milestones	Original Date	Revised Date	Date Completed
PTCS			
Identify 1" level contributors to pointing error	09/30/04	deferred	
Ready for prototype W-Band operation under benign conditions	10/01/04	02/01/05	
Ease of Use			
Beta Release of Observing API	02/16/04	07/09/04	07/09/04
Production Release of HLAPIs & Online Filler	03/31/04	Task reorganized	
Beta Release of GO replacement	12/31/03	08/15/04	09/30/04
Complete "Phase 4" of Observing API (near-earth objects, source catalogs)	06/30/05		
Remote Observing Specifications written	12/31/04	05/15/05	
Data Handling			
Generate requirements for imaging	12/31/03	09/01/05	
Analysis Conceptual Design Review (In-Progress Software Review)	02/09/04	08/30/04	08/30/04

Green Bank Telescope

Milestones	Original Date	Revised Date	Date Completed
Standard observing modes and data reduction cases defines	06/30/04		08/15/04
Beta release of IDL package for standard observing modes	12/31/04		
First draft of GBT Science Data Model	03/31/05		
Spectral Baselines			
Conduct experiments to characterize Q-Band baselines	08/01/04	10/15/04	
Move Q-Band mixers to room temperature	11/01/04		
IF Temperature stability experiments	08/01/04		09/01/04
Ka-Band (1cm Rx)			
Penn Array Receiver			
Fix simulation problems, analyze data	08/31/04		08/31/04
Fabricate and deliver crate and mounting hardware	12/31/04	10/31/04	
Detectors Delivered to Penn	05/17/04	10/31/04	
Full Lab integration at Penn	09/6/04	02/15/05	
GBT Commissioning	02/21/05	03/31/05	
3mm Receiver			
Restart Project	11/15/03	10/01/04	
Revise Project Plan	12/01/03	11/15/04	
Caltech Continuum Backend			
Complete CCB design	03/31/04	10/31/04	
Master Board laid out	04/30/04	12/31/04	
FPGA program synthesized and simulated	03/31/04	12/31/04	
Finish Packaging drawings	05/31/04	12/31/04	
Construction and lab testing complete	08/27/04	03/31/05	
Commission on GBT	09/06/04	03/31/05	

GBT and Green Bank Overview

We have made good progress on several project and operational areas during this quarter. Investigations and trials of the azimuth track are proceeding well. The trial splice-plate experiment has given good results, and a trial of an alternative wear-plate material with better fatigue resistance has also given good results. Finite element analyses by both an external contractor and NRAO engineering staff have yielded some valuable results. Metallurgy of the original wear plate material indicates that it may have had lower fatigue resistance than is typical for that type of steel. We are organizing another engineering review in the fourth quarter of 2004.

Green Bank Telescope

Structural inspections of the GBT were completed this quarter. Overall, the structure is in very good shape. Areas requiring attention, which includes some weld repairs and water ingress locations, are being addressed at this time. A conversion of the azimuth wheel bearing lubricant from grease to oil has been completed with good results.

Following initial engineering tests last spring, the Ka-Band (26-40 GHz) Receiver and ancillary instruments were completed over the summer and installed at the end of the quarter. This receiver will bring significant new scientific capability, particularly in areas relating to high-redshift molecular line detection and correction of point source contamination of cosmic background fields.

The digital electronics group made good progress in implementing pulsar Spigot modes of the Spectrometer, in development of the cross-correlation test fixture for the Spectrometer, and in designing a replacement for the Spectrometer Long Term Accumulator board. In addition to the Ka-Band project, the microwave group worked on a significant modification to the Q-Band Receiver to improve stability, calibration, and spectral baselines. The group is also nearing completion of a project to reduce temperature instabilities in the IF system that can result in spectral baseline problems. The RFI group continued its efforts to reduce RFI on site and in the surrounding community, which has helped enable some important science results at low frequency. Progress was also made on RFI monitoring stations on site.

The Precision Telescope Control System (PTCS) project advanced on several fronts. New pointing models were derived that compensate for azimuth and elevation residuals. Analysis and observing techniques were refined for characterizing the large-scale surface figure of the dish. Good progress was also made on instrumentation, including prototyping of new quadrant detector and laser rangefinder designs.

The Software Development Group issued two new releases of the Monitor and Control (M&C) System, and a beta release of a new Observing Application Programming Interface. The latter features a "scheduling block" concept that follows ALMA specifications. The IDL data reduction project, which will provide a system for interactive analysis of spectral line and basic continuum data, was also initiated. This system makes use of the commercial IDL package, which is familiar to and easily extendable by a large number of GBT users.

Azimuth Track

During this quarter, Phase II of the Finite Element Analysis was completed, which projected that the trial modification made to the baseplate joint should have a service life of at least 20 years. The analysis found that the stresses do not exceed the strength of the grout between the concrete foundation and the baseplates, and a wear rate for fretting was predicted. This phase of the analysis failed to adequately pinpoint a cause for what are now the most critical problems, cracking of the wear plates and bolt failures. Additional analyses are under way to model the micro-effects in the wear plates,

particularly at the joints. This analysis involves an element mesh giving better resolution, and a different load pattern is being tried to better model the wheels. This work should finish in the fourth quarter of 2004.

The defect indications found previously in the wear plate atop splice 45 have been found to be artifacts of the measurement. The plate was replaced and cut up for metallurgical examination. No crack-like defects were found. A review of the method used by the ultrasonic testing company determined that constructive interference of the sound waves caused the false indications. Both the modified baseplate joint and the new wear plate are performing well.

Material from the manufacture of the original wear plates in 1992-1993 were found at the fabricator's facility in Texas. Samples from this material were tested and found to have low impact strengths compared to common values given in industry literature. This reduces the fatigue life of the plates. But, the results also show that service has caused deterioration. Tests of the material used in replacement plates is in line with industry values, meaning that we are gaining back some service margin in the replacement plates. Additional improvement in margin can be realized by improving material. A trial material having better fatigue resistance and impact strength was used when two cracked wear plates were replaced in September. This material is performing satisfactorily.

We continue to pursue finite element analyses that may point to a mechanism for the cracking of the wear plates. An internal panel review, and an external review of our efforts and plans, will be held in the fourth quarter of 2004.

Telescope Operations Activities

The Operations Maintenance effort worked the second quarter with four ten-hour maintenance days per week. Painting has been a major activity, primarily in the back-up structure. Modifications were made to the air intakes to the servomotors to correct the ingress of rain, and mist-eliminating filters were installed to reduce moisture brought into the motors from heavy fogs. Water in these motors had led to one failure and a pending failure. The azimuth wheel bearings were also converted from grease lubrication to a fully flooded, high-viscosity oil bath. Wear product in the trial bearings was significantly less over the preceding six months.

Modjeski and Masters returned to the site this quarter to continue the structural inspection. The alidade and the right half of the backup structure were inspected. This inspection was accomplished significantly ahead of schedule. Defects were recorded and are in the process of repair. Repairs of last year's inspection findings are also in progress. To correct the ingress of water into joints between members, the joints are being recaulked during painting, and tablets inserted to create a vapor inhibitor against interior surface corrosion. The tablets dissolve and form the vapor when the come in contact with water or water vapor.

Green Bank Telescope

The Operations group supported the observing schedule in the usual manner by performing feedhorn and receiver changes. Modifications were made to the GBT control room to remove tripping hazards. Operations also gave significant support to the re-commissioning of the 45-foot telescope for the Solar Radio Burst Spectrometer project, and replaced a brake on the 85-3 antenna.

Green Bank Electronics

Green Bank Electronics provides support for all electronic systems at Green Bank, including telescope controls, backends, RF equipment, audio-visual equipment, network installation and maintenance, radio system work, and machine shop electronic repair. Some specific activities of the three Groups are reported below.

Digital Group Activities

Most of the Digital Group's time was spent on Precision Telescope Control System (PTCS) activities, 45-foot Servo support, Spectrometer support and development, and the Caltech Continuum Backend project.

About 4 FTE's were supplied to the PTCS project. This consisted of sensor construction, installation, maintenance, and calibration work, along with active surface maintenance.

The 45-foot servo system work for this quarter consisted of design and construction of a new servo system for the 45-foot telescope, as well as support for getting the antenna running under control of the antenna control software used for the OVLBI project. This antenna is being readied for use with the Solar Radio Burst Spectrometer, which will study the Sun over the next two years.

During this quarter, spectrometer development concentrated on three areas: LTA card replacement, cross-correlation, and spigot testing. The LTA replacement project produced most of the design of the PC Boards. Spigot mode-testing concentrated on timing problems, artifacts in the signals, and development of 200 MHz modes. Cross-correlation testing concentrated on the development of a test fixture, and, in particular, a filter module similar to that in our IF system. The spectrometer is in general fairly reliable although it occasionally produces obviously bad data. Thus, trouble-shooting and repair accounted for only a small amount of the time spent on the spectrometer. About 2 FTE's are provided to Spectrometer work.

The Digital Group is supplying engineering effort to assist the Caltech Continuum Backend project. We are designing the analog front end, including the receiver detector preamp, the digital sections of the backend, and the packaging design. About 1.5 FTE is assigned to this task. Digital Group personnel are also involved in the GBT servo system support, repairing and maintaining printers, network cabling, and communications hardware on the GBT.

Green Bank Telescope

Microwave Group Activities

The Microwave Group provides support for the GBT receivers, IF/LO systems, and the site radio, intercom, and GBT phone systems.

The K-Band receiver was in use all summer for a monitoring project. The Q-Band receiver was removed from the telescope and studied to determine the cause of unusual baseline shapes. The X-Band receiver was modified, adding a polarization switch, and a new bandpass filter to accommodate an observing request. The PF2 receiver was installed and used for astronomy, while the PF1 receiver had a filter bank repaired.

The IF system received some attention this quarter. The system was tested and adjusted for best performance with the new fiber optics modulators. New IF amplifiers are being designed and tested. A spurious signal near 300 kHz affecting Spectrometer low-bandwidth data was eliminated. Various module instabilities and failures were repaired, and efforts continue to improve gain stability with better temperature control and other steps.

The outdoor antenna range upgrade is nearing completion. This will provide better positioning, instrumentation, and software for doing antenna measurements on the outdoor range. Work continues to outfit the indoor/outdoor building with mounts and hoists to allow us to more easily test our GBT Gregorian receivers there before putting them on the telescope. In support of various projects, we continue to develop amplifiers around commercial MMIC chips, including a 8-18 GHz LO amplifier and a 0.5-8 GHz medium power IF amplifier. Several microstrip bandpass filters were also designed, developed, and produced. Additional Microwave Group activity is noted under the baseline investigation project and the Ka-Band project.

RFI Management

Per observer requests, recommendations for favorable regions in S- and C-Band were made. The S-Band observer initially reported that the recommended region, 1700 - 2320 MHz, was virtually free of RFI throughout the observation and that 6 new binary pulsars were discovered in a single weekend. It was later determined that in fact 13 new binary pulsars were discovered. The RFI group also provided support in the experiments conducted with the Digital Bruny Island Radio Spectrometer (DBIRS). RFI management assistance was provided to Don Backer in the implementation of his VHF interferometer at 85-1. RFI call outs in the PF1 450, PF1 800, L-Band, and in the 20 - 70 MHz band were supported.

The National Radio Quiet Zone (NRQZ) office completed eight requests for preliminary evaluation on 31 transmitter sites. Forty-eight regular applications for 137 sites were also completed. ERPd restrictions were requested on 11 sites. Four transmitter sites were inspected for National Radio Quiet Zone (NRQZ) compliance. The implementation of our first Globalstar and DirecWay systems were coordinated.

A small number of cable TV leaks and power line RFI sources were suppressed. Only one noisy electric fence was encountered during the quarter. This may be indicative of the success of IPG outreach measures in this area as this is peak electric fence RFI season.

Extensive upgrades on the RFI monitoring station at the 40-foot telescope were completed during the quarter. Improvements on the signal distribution system, grounding system, tower hoist, HVAC system, floor, and entryway are examples. Progress on the GBT RFI monitoring station continued as the design for 100 MHz - 3 GHz coverage was completed and the required hardware was purchased. The circuit design for the GBT RFI monitoring station control box was completed and is in the queue for PCB layout. A new, more capable, Az-E1 mount was purchased for our 12-foot RFI survey antenna. Improvements in our anechoic chamber facility and portable RFI measurement setup were also planned. The retrofit of the PMRF 0.5 - 18.0 GHz spinning direction finding system was completed.

As a part of outreach efforts, the RFI group provided support to the *Star Quest* group and hosted the *Quiet Skies* Research Experiences for Teachers (RETs) group for several weeks. In support of Pocahontas County Emergency 911, RFI group members joined forces to identify and mitigate a RFI source at the emergency services base-station site on Snowshoe Mountain. Presentations and demos were provided to the RETs, Research Experiences for Undergraduate (REUs), and the *Rare Cats*. Some Pocahontas County High School job-shadowing students were also hosted. The trend of increasing public interest and support for the NRQZ was indicated by a three day visit from Smithsonian Magazine. A visit from the FCC's International Radiocommunication Branch Chief was hosted and received very high marks. A last-minute site tour for two FEMA communications techs was requested and accommodated. A WVMR phone interview on wind power was supported and an appearance was made in one of our *Quiet Skies* RET's virtual classrooms.

The shielded enclosure for the Green Bank Science Center C3 compact fluorescent fixtures was completed and filters are on order. A new plan for managing on-site RFI from computer monitors is in place. Extensive repairs were completed on one of our shielded doors. T. Minter completed and posted a PF1 800 RFI summary.

Mechanical Engineering and Central Instrument Shop

This quarter the Mechanical Division completed the design and fabrication of a load test bed for testing the Solar Radio Telescope's improved servo system. The Mechanical Division also designed and fabricated lifting equipment for the new ALMA Dewar. Detailed design for the Penn Array electronics crate will be completed early in the fourth quarter. Work is also well under way on the design for an RFI monitor station for the GBT feed arm tip. The Mechanical Division continues working with the GBT azimuth track group.

Green Bank Telescope

The Central Instrument Shop completed the fabrication of new adapters and ducting to improve the air cooling for the GBT azimuth and elevation drive motors. The shop continued the fabrication of parts for the GBT MM Converter, RFI mitigation, and several receiver projects. The shop also provided support for ALMA including a number of LO Assembly parts and a large Dewar lifter. The Shop completed an order for EVLA phase shifters. The shop is also providing support for an experiment being conducted by Rich Bradley (CDL) in Green Bank. Next quarter the shop will be completing fabrication of the Penn Array electronics crate and HDPE lenses.

Software and Computing

Software Development

The Software Development Division (SDD) produced two regular releases of its key product, M&C: v4.5 (August 19) and v4.6 (September 30). Key additions included a new pointing/focus model, to be tested in the upcoming quarter, which implements residual corrections to the pointing and focus configuration model. Residual tables and the model for calculating dynamic corrections are automatically loaded whenever a new pointing and focus model is selected. Models can be changed on-the-fly using the engineer's and operator's control interface. Significant work was done on preparations for the installation and commissioning of the Ka-Band receiver and the common millimeter downconverter. In particular, because the new receiver is used with the downconverter, an extra frequency calculation is performed which requires additional up-front configuration, and this capability was added to software.

Other smaller changes were also implemented. The IF system was augmented to support a new backend, the Green Bank Astronomical Signal Processor (GASP). Some new configuration modes were added, including one that sets up for the Digital Continuum Receiver (DCR) but routes through the analog filter rack. A new wind velocity sensor on a weather station was integrated. Error messages were added to note when power supply voltages on the converter rack leave their nominal ranges. If LOs become unlocked unexpectedly, a warning is now issued. There are now improved diagnostic messages for the active surface when LVDT errors occur.

To support improved telescope reliability, the switching signals selector was ported to Linux. Control system configuration files were defaulted so that they can no longer be specified directly when restarting the system. This addition prevents the accidental access of the live telescope in cases where simulators are required instead. The low-level interface to the telescope received some incremental improvements, such as one that retains control system parameter settings even when individual devices fail. The archivist was improved so that it is no longer as sensitive to faults in samplers, and it recovers well from sampler failures. A persistent problem where an abort occurred at the end of a series of spectrometer observations was fixed. A warning is now issued if the LO1A or LO1B synthesizers lose the 10 MHz reference signal.

Green Bank Telescope

Although more significant work is planned for the fourth quarter, there were several incremental updates to GFM, the GBT quick-look data display. The Ka-Band receiver, which is planned for installation on the telescope in the fourth quarter, is now supported. Directory navigation problems were resolved. Visual cues were added to make it easier to tell whether one is working online (actively connected to the live telescope) or offline.

Significant strides were made with the Ease of Use and Data Handling projects. Also during this quarter, members of the SDD participated in activities outside of Green Bank, including the ALMA Computing Design Review and ALMA Common Software training in July, and a design meeting for the Penn Array Receiver at NASA Goddard in August.

Computing

Summer Students

The summer students have now left and all their computers have been or are being redeployed to those in greatest need. The six network connections in the basement are now available for connecting laptops.

Network Improvements

Much work this quarter has gone into documenting the site's network hardware and connections. A few surprises were discovered, such as extra hubs that did not appear on the existing network map. This mapping is not yet complete but the division is now in a much better position with regard to where equipment is physically located, what we actually have, and what needs to be upgraded. The new documentation is wiki-based to allow easy updating by staff involved with the network.

A new Cisco switch has been purchased to upgrade the existing Xylan switch in the equipment room and provide extra connections and more bandwidth between machines. This switch will be deployed in the fourth quarter. In addition, CIS has provided funding to complete the wiring of the residence hall and new equipment is being specified. Completion is expected in the early part of the fourth quarter.

A gigabit switch has been installed in the spigot rack to provide a high-speed private data network between data reduction machines and the spigot. Currently euler, spigot, and spigot2 are connected to this network, and euclid and thales will be added shortly.

Further upgrades of the site's Xylan switches are planned.

Green Bank Telescope

Redhat Successor

Much discussion and evaluation work has been done by the unix administrators to determine the safest, least disruptive, and most stable path to a replacement for Redhat 9.0. The current candidate is Redhat Enterprise Workstation 3.0. Transitioning to this distribution is likely to be almost transparent. The licensing agreement we are considering will allow staff to install this on their home systems at no charge.

Hardware

Additional external disc packs have been ordered to help with the transfer of the very large spigot data sets. Two of these disc packs are connected via multiple external serial ATA connections. These discs should be considerably faster than the USB and firewire 400 discs and a little faster than the firewire 800 disc.

More firewire 800 interfaces have been purchased, again to assist with spigot data transfers. These will be fitted to the necessary machines in the near future.

A major purchase this quarter has been a NetApp disc storage system. This unit will replace some of the NFS storage space currently provided by prospero. As well as providing a more stable and reliable storage environment, it brings Green Bank in line with Charlottesville and the Array Operations Center (Socorro) where these devices have been in use for some time. In addition to being more stable and reliable, the block level backups that are generated automatically will reduce our reliance on tapes for short -term backup.

Two more high-end data reduction machines have been ordered and will be deployed in the fourth quarter. Both have large discs, fast processors, and sufficient memory for reducing large data sets. Both the new machines will be on the booking system.

Projects

Precision Telescope Control System (PTCS)

The third quarter of 2004 saw few changes to the operational PTCS systems, as the summer months are dominated by low-frequency observing. The main PTCS activities consisted of preparations for the start of fall high-frequency observing, and continued instrumentation development.

Pointing/Focus: One further temperature sensor failed during the quarter. Although the failure rate remains low, it is still higher than expected or desired, and we may consider a program of sensor replacement during summer 2005. As noted in the previous report, sensor failures are now dealt with by constructing a new model, which excludes the faulty sensor, until such time as it can be replaced.

Green Bank Telescope

During this quarter we have developed and implemented a number of improvements to the handling of pointing models in the Antenna Manager. These include the implementation of pointing residuals as a function of azimuth and elevation, which at least initially will be used to compensate for irregularities in the azimuth track. The complete pointing/focus model, including gravitational and thermal coefficients and the residual tables, is now contained in a database, and models can easily be updated on-the-fly. Our latest models, which utilize all of these features, will be tested astronomically in early October.

The significantly improved pointing catalog described in the previous Quarterly Report has now been released and is in production use. Work continues on upgrades to GFM, albeit at a low level, since the relevant software development division's staff have been allocated almost completely to Ease of Use improvements for the quarter.

Instrumentation: Good progress continues to be made on new instrumentation. The IR imager was used in June and July to prototype our ability to measure thermal gradients in the primary, for use in quantifying large-scale surface errors. The measurements were successfully completed, but early indications are that they will be less directly useful than we had initially hoped. The measurements do contain valuable information on the thermal behavior of the primary, however, and will be fully analyzed.

New quadrant detector and laser rangefinder designs are being prototyped. Experiments with the prototypes will provide data for use in system studies that will determine the feasibility and sufficiency of a new GBT metrology system.

Reinstallation of the existing Quadrant Detector was delayed due to higher priority activities; this will now occur in the next quarter.

Surface Efficiency/Holography: Over the summer we developed observing and data analysis procedures to allow quick astronomical measurements of coma and astigmatism. Initially, these will allow us to refine the existing subreflector focus-tracking model, which was developed at 2 GHz and 10 GHz, using rather laborious procedures in the early commissioning days. These procedures have been tested at 20 GHz, and we expect to make the final measurements using the high end of the Ka-Band (26-40 GHz) receiver as it is recommissioned in October. These measurements will allow us to improve the large-scale equivalent surface errors, either by improving the alignment of the subreflector, or directly using the active surface.

Problems with the Q-Band receiver and efficiency measurements made during the spring are now believed to be understood, and significantly improved analysis techniques (use of MATLAB for data analysis, more sophisticated methods for processing tipping data, etc), have been developed. Again, these are awaiting reinstallation of the Q-Band receiver towards the end of 2004.

Bojan Nikolic, a graduate student from Cambridge U.K., has accepted a one-year post-doctoral position, and we hope that he will commence work in December, upon completion of his thesis. The main focus of his efforts will be to continue to refine and improve the "out-of-focus" (OOF) holography procedures which were used to good effect in the Spring.

Staff Effort/Future Planning Jim Condon, the PTCS Project Scientist, has recently been appointed interim NRAO Deputy Director. Dana Balser and Richard Prestage also continue to spend a considerable fraction of their time on non-PTCS activities. In addition, the GBT Software Development Division remains significantly overloaded. To accommodate these resource issues, we have had to drop the PTCS Project to a "priority 2" project until at least spring 2005. We are currently reviewing our project plan and schedule to decide how best to accommodate these events.

Ease of Use Project

The Ease of Use project is underway to make it simpler for observers to configure the telescope and perform observations with the GBT. It includes the ability to define observations in advance of actual observing, the ability to execute those observations, improved monitor and status information while observations are executed, and an improved real-time display. Major advances have been made throughout this quarter. The Observing API, was released in beta form at the end of Q2, was integrated into a Scheduling Block-based observing process. The culmination of this process is a scheduled evaluation release of the GBT Observing Tool (OT) during the first week of October.

The GBT OT includes the following software development efforts:

- The GBT **Observation Management Database**, which implements an observing data model. This tracks the content and execution history of all Scheduling Blocks executed on the GBT, and is fundamental to all OT applications. The physical database is local to Green Bank.

- A graphically-oriented **Scheduling Block Builder**, used by standard observers to easily build Scheduling Blocks which can set up and observe in all GBT standard observing modes. The GBT Scheduling Block Builder was developed from specifications for the ALMA OT. It produces a script which can be uploaded to the GBT Observation Management database whether a user is on-site or at their home institution, thus natively supporting remote preparation of observations. The application has been developed in Java with a web presentation for easy deployment; users will simply connect to a web page to prepare and submit observations, or download the Java application in full for offline use.

- A graphical interface for **Observation Management**, used by all observers to submit their observations to a first-in-first-out queue, and by expert observers to edit and tweak the contents of their Scheduling Blocks directly. This enables fully interactive single-dish observing in addition to supporting automated dynamic-scheduling by being Scheduling Block driven. A

validation mechanism is also in place; no syntactically invalid operations are sent to the telescope because Scheduling Blocks with errors cannot be saved to the database. This should save valuable telescope time.

- The **Scheduling Block Executor** which allows the Configuration API, Observing API, and IF power balancing routines to be fully accessed using shorthand that allows the astronomer greater control over his or her observation without having to learn extensive programming constructs.

An evaluation release means that the package has been written and tested to ensure a level of quality suitable for production use, but the release must first be critically evaluated by staff astronomers before being made available to visiting observers. As a result, work planned for the next quarter includes training staff astronomers and operators, supporting pulsar observations, and providing improved status information that will enable remote observing for many pulsar observers. It is anticipated that the status information will be enhanced in future cycles and become useful to all classes of observing.

The Ease of Use project was evaluated in-depth at the GBT e2e Software Review on August 30. The panel's summary of the project in their report stated that the planned continuing efforts were supported, "both to make observations easier for outside observers and to reduce the observing pressure on the GB staff. Some good design steps have clearly been made."

Data Handling Improvements Project

This project covers all aspects of observer-facing software that are encountered after an observation is successfully made, from data quality assessment and quick look capabilities through imaging. Work during this quarter focused on ramping up the development of IDL modules for reducing the data from the GBT's fundamental observing modes, and crystallizing short-term and long-term plans for single dish data reduction. The plans were presented at the GBT e2e Software Review on August 30. The panel approved the approach of using IDL development as a means of generating a draft GBT Science Data Model (SDM), as well as the long-term vision of Python-wrapped C and C++ components compatible with an Observatory-wide framework. Complete documents from the review are available on the GB Wiki at *http://wiki.gb.nrao.edu/bin/view/Software/*.

Additionally, Ron DuPlain (co-op student) completed his first of three terms with the GBT SDD this quarter. His project, "Data Quality Diagnostics for the GBT" bridges the quality aspects of the telescope control system, which produces raw data, and the scientific usefulness of that data. For example, pipeline processing should not be initiated if the data is sufficiently corrupt that the science products would be unusable. Quality metrics should be archived, so that an astronomer who is seeking the archive for a past observation of a particular source which is in the public domain can select the highest quality data, if more than one set is available. The work to-date has involved an analysis of the issues associated with data quality diagnostics for the GBT. These can be used to increase the effectiveness of software maintenance, as well as to identify which quality metrics should eventually be

stored with GBT data in the NRAO archive. The student successfully completed a project charter, and will return in the winter to begin work on the diagnostic software application itself.

After the software review, scientists and developers on the IDL project launched into full scale prototype development. Many achievements were made, including initial work on upgrading the IDL plotter, integrating functionality written by Tom Bania (Boston University), and writing a generalized data input/output module from which the draft science data model will emerge. Because the system will eventually be downloaded (and perhaps augmented) by astronomers and IDL developers at many locations, the code base is resident at Source forge, a public repository with free distribution mechanisms. Development environments and functional prototype code are also now available in both Charlottesville and Green Bank. Several issues were discovered as the data input/output modules were written, particularly with respect to file size and performance limitations for the largest datasets. These will be explored and resolved in the upcoming quarter. During this quarter, the IDL work has gathered significant momentum and early results are already being presented. Plans for the fourth quarter include completion of the beta package, and an IDL Design Workshop which will involve representatives external to NRAO to consult on the progress and direction.

The AIPS++ DISH application is still being supported and maintained at a minimum level, and small additions have been made throughout the quarter for operational support and new instrumentation needs, for example in the Measurement Set filler.

Baseline Investigations

The major work this quarter was the testing and analysis of the Q-Band receiver to determine the source of baseline shape. We were able to improve the bandpass response by moving the single-balanced mixer to 300K from 15K, and by improving the image terminations. The receiver will be installed on the GBT for re-commissioning and observations November 1, 2004.

An additional task that is being done in connection with the baseline project is continuing the IF system stability enhancements through stabilization of temperatures in the Converter Modules. That work is nearing completion.

Enhanced calibration and signal processing algorithms continue to be investigated by the scientific staff.

A final report, in the form of an addendum to EDIR 312 will document the final state of the system. The project will finish about November 15, 2004.

Green Bank Telescope

Penn Array Bolometer Camera

Penn cooled the final cryostat with the optics tower and flexlines installed and obtained good hold times of 40 hours on the He4 stage, and 70 hours on the He3 stage. The cooldown time was longer than expected (96 hours), which bodes well for the thermal stability of the focal plane but could be an operational problem. Penn is investigating ways to achieve shorter cooldowns without sacrificing much stability once cold. The metglass used to magnetically shield the optics tower was found to be fragile when thermally cycled, and this is also being investigated. On the optics side, anti-reflective grooves were designed and machined into the test plastic lenses, and the final filters were received.

Goddard manufactured an assortment of test bolometer packages complete with absorptive coating. Results from tests on these will be used to specify the recipe for the final bolometers. The MkIII electronics design and firmware upgrade is nearly complete and will enter testing in fall. Goddard has also been working on the Data Acquisition software (the Instrument Remote Control package or IRC). IRC has been going through a major revision and when this is complete the package will be released to Penn and NRAO to work on the code to interface with the GBT and Penn Array Cryostat. IRC will be used for early test runs on the GBT with a plan to eventually migrate over to GBT's YGOR-based system for control and data acquisition. In August, personnel from Green Bank and Penn attended a two-day working meeting at Goddard to begin learning how to implement new housekeeping and telescope control components within the IRC architecture.

The mechanical engineering division at Green Bank has been working with Penn to determine final packaging, cabling, and mounting arrangements. Several bugs in both the Penn Array data simulation code, and the OBIT data continuum imaging package, were identified and fixed.

New Receivers Backends

Work on the Caltech Continuum Backend (CCB) design continued, focusing on defining the interface between the instrument backplane and its FPGA and the daughter cards and their FGPAs. After a number of revisions to make the bus more robust, the master/slave interface and backplane pinouts were agreed upon. Consequent changes to the FGPA program architecture and daughter cards designs were made and documented. A draft schematic for the daughter card was circulated for comment, with the intent that it proceed to layout and fabrication in the fall. The CPU board which will be used to run the CCB was ordered and received so that packaging issues could be examined. Early in the quarter Caltech's updated network interface library was compiled and vetted against several configuration cases. In July 2004 Chilean graduate student, Cristobal Achermann, joined the CCB project for the duration of a four-month Graduate Student Internship in Green Bank working with Randy McCullough (GB Electronics) on the CCB design.

Green Bank Telescope

The GBT 26-40 GHz receiver was prepared for installation and commissioning in October 2004, following successful engineering tests on the telescope in the spring. Improved phase shifters were installed in the front-end polarizers, providing improved circular polarization purity. The engineering tests encountered several intermittent total-power instabilities, which were addressed during the quarter. The frequency converters used with the 26-40 GHz receiver were completed and will be installed in October as well.

Very Large Array and Very Long Baseline Array

Very Large Array (VLA) Highlights

The first observing began on the fourth operational series of VLA-Pie Town link science. The fourth quarter of 2004 will mark the first time that the A configuration and Pie Town link have occurred since the new 43 GHz and lower noise 22 GHz receiving systems have been completed. Since the fall/winter observing trimester provides the best overall weather and phase stability at the VLA, a large number of high-frequency observations have been scheduled, particularly those exploring both Galactic and extragalactic star formation.

During the third quarter, we completed the upgrade of the encoder electronics on the last of 28 VLA antennas. This upgrade was intended to reduce or eliminate the cyclical pointing errors in both elevation and azimuth that were caused by inadequate quantization and ancient electronics. The periodic pointing errors could not be removed by reference pointing, since they depended on the specific azimuth and elevation, and did not repeat from one source to another. With the completion of the upgrade, VLA antennas consistently show a pointing stability better than 6 arcseconds, as is required for the best performance at 43 GHz observing frequency.

In the second quarter of (calendar) 2004, we began looking at the impact of the transition from VLA to EVLA. During the third quarter, it was recognized that this task was considerably more involved than constructing a simple set of milestones, but required an overall resource assessment in conjunction with the schedule for EVLA hardware and software. Therefore, during the last quarter, work commenced on two much more detailed transition plans from VLA to EVLA. The first is a scientific transition plan, assessing the scientific usage and personnel requirements during the transition phase from 2005 through 2012. The second is an operations transition plan that will define the evolution of operations functions, staffing required to support those functions, and the requirements for long-term infrastructure maintenance. We expect that the first public versions of these two plans will be available by the middle of 2005.

Very Large Array and Very Long Baseline Array

Very Long Baseline Array (VLBA) Highlights

A refurbished subreflector was installed on the Brewster VLBA antenna during the regular maintenance visit in August 2004. This subreflector had been removed from Pie Town last year, and was measured and resurfaced at the VLA site earlier in 2004. Tests show that the 43 GHz aperture efficiency at Brewster has been increased from 30 to 50 percent, and the gain curve versus elevation now is much better behaved than previously. Given the improved performance of the subreflector, it now makes sense to develop a plan to install a 3 mm (86 GHz) receiver at Brewster, either as a new system or by moving a system from the poorly performing antenna at Hancock.

Mark 5 recording systems were installed successfully at four VLBA stations and the GBT; a total of five VLBA stations now have been outfitted. Three of the VLBA stations were equipped using operational funding, and two more (plus the GBT) were funded by ESA and the European VLBI Network to support tracking of the Huygens Probe at Saturn in January 2005. NASA funding for Mark 5 recorders at three more stations was received late in the quarter, also to support Huygens, so we anticipate that three more VLBA stations will be outfitted during the fourth quarter. Since operational funds were sufficient only to buy enough disk media to operate three stations full time, we plan to convert only Pie Town, Los Alamos, and Kitt Peak to full-time Mark 5 operations at this time. After gathering further operational experience, we expect this conversion to be complete by December 2004.

Management and Scientific Services Milestones

Milestones	Original Date	Revised Date	Date Completed
Complete Project-Oriented Sci. Staff Reorganization	05/15/04	07/15/04	07/08/04
AIPS++ Stable Release 7	07/15/04		08/23/04
Implement Mark 5 Recorders on Two VLBA Stations	12/31/04	08/31/04	08/27/04
Implement Mark 5 on Three VLBA Stations + GBT	10/15/04		08/27/04
AIPS++ Stable Release 8	09/15/04		09/18/04
VLA-Pie Town Link 4th Operational Session Begins	10/01/04		09/23/04
VLA/VLBA General Proposal Deadline	10/01/04		
Initial Version of Proposal Submission Tool	09/01/04	10/04/04	
Global 3mm VLBI Session	10/13/04		

Very Large Array and Very Long Baseline Array

Milestones	Original Date	Revised Date	Date Completed
Pie Town 3mm Test After Re-setting Panels	05/31/04	10/31/04	
New Mexico Symposium & Jansky Lecture	11/15/04	11/10/04	
Complete VLBA Pilot Program for S/C Navigation	01/30/04	11/15/04	
AIPS++ Stable Release 9	11/15/04		
Mark 5 Recorders Installed at Eight VLBA Stations	11/30/04		
VLBI High Sensitivity Array—First Observations	11/01/04	12/15/04	
Three VLBA Stations to Mark 5 Full Time	12/15/04		
AIPS Frozen Release of 31DEC04, Begin 31DEC05	12/31/04		
VLBA Huygens Probe Tracking Experiment	01/14/05		
AIPS++ Stable Release 10	01/15/05		
VLA/VLBA General Proposal Deadline	02/01/05		
AIPS++ Stable Release 11	03/15/05		
Trial proposal tool released for VLA and VLBA	05/01/05		
VLA/EVLA Transition Operations Plan, Version 1	05/27/05		
VLA/VLBA Proposal Deadline; VLA Large	06/01/05		
Full proposal tool release for VLA and VLBA	09/01/05		

Computer Infrastructure Milestones

Milestones	Original Date	Revised Date	Date Completed
Phase 3 AOC Rewire	12/30/04		09/30/04
Replace all systems >6 years old	09/30/04		08/15/04
Outfit 2nd EVLA antenna network	09/15/04	10/15/04	
Examine LDAP support	08/31/04	10/30/04	
Expand archive to 17TB	10/30/04		
Examine OS/X support	09/30/04	11/30/04	
Migration to Windows 2K domain	07/31/04	12/31/04	
Examine Redhat Enterprise support	12/31/04		

Operations Software Support Milestones

Milestones	Original Date	Revised Date	Date Completed
Correlator controller changes to Modcomp	03/30/04	07/31/04	09/01/04
Correlator controller integrate line/continuum	06/30/03	07/31/04	07/01/04
Update VLBA stations software for MKV	07/01/04		09/29/04
Update VLBA correlator software for MKV	07/01/04		09/29/04
Track program modifications for MKV	10/30/03	10/30/04	
Online VLA recording to DAT	02/01/04	10/30/04	
Satellite tracking software mods	02/01/04	11/01/04	
Correlator controller bug fixes	03/31/04	12/15/04	
Correlator controller transition plan	02/28/04	12/31/04	
Translate and copy stored VLA monitor data from 9-track to DAT	03/01/04	06/30/05	
Transcribe VLA observe/system files	11/30/02	11/30/05	

Electronics Milestones

Milestones	Original Date	Revised Date	Date Completed
Pie Town Link (LO/IF)			
Complete construction & checkout of spare L6, F4 and Pie Town data sets. Develop a full system checkout procedure	09/30/04		09/10/04
Mark-5 Project			
Production observation with Mark-5 units at KP, PT, LA	10/22/04		
Mark-5 AOC playback system #1 Operational	12/15/04		
Lab Services			
Move the Drafting Department to the second floor	09/15/04		08/17/04
Receivers (FE)			
Complete spare K-Band receivers #29 for VLA	09/15/04		09/15/04
Replace S-Band receiver at Ft. Davis and perform a RFI survey with the new receiver	11/19/04		

Very Large Array and Very Long Baseline Array

Milestones	Original Date	Revised Date	Date Completed
Improvements			
Investigate the impact of Bandpass Filters install at S-Band on RDV observations. VLBA Owens Valley			07/15/04
Upgrade the ACU power supply & backplane at VLBA Pie Town, NM	09/15/04		07/20/04

Engineering Services Milestones

Milestones	Original Date	Revised Date	Date Completed
Complete A array reconfiguration	09/17/04		09/09/04
Mechanical Group			
Resurface Pie Town subreflector	06/30/04	07/27/04	07/21/04
Brewster maintenance visit	08/09/04		08/09/04
Install refurbished subreflector at Brewster	08/09/04		08/09/04
Adjust panels Pie Town	05/15/04	09/30/04	09/28/04
Mauna Kea azimuth rail repair	06/16/03	09/30/04	08/09/04
VLBA second drive wheel construction	06/30/04	09/30/04	
Owens Valley maintenance visit	10/04/04		
Electrical Group			
Control Building Lightning Protection System mods	07/20/04		07/20/04
Transformer PMs	08/31/04		08/31/04
Blower Modification Evaluations	09/30/04		09/30/04
Completion of tachometer board	09/30/04		
Fiber to Cafeteria	12/31/04		
Site & Wye Group			
Complete track repairs between BN6-AN5	12/31/02	10/31/04	
ES Engineering Group			
X-K Dichroic design	09/15/04		

Very Large Array and Very Long Baseline Array

Interferometry Software Division

AIPS

Key Developments

- Two new tasks to allow automatic editing were released in relatively complete form. FINDR applies various data-averaging algorithms to determine normal values and uncertainties in baseline-based and antenna-based data values. FLAGR uses similar algorithms with user-supplied cutoff values to flag the data. FLAGR also flags on out-of-range data weights.

- CLCOR was supplied with code to correct VLBA data for the difference between gravitational bending of a source at infinity and sources within the Solar System. The new ephemeris routines used provide accurate locations for the Sun and planets and were shown to correct existing observations of NASA satellites to give extremely accurate position information.

- The VLB astrometric task ATMCA that allows multiple calibration sources to provide a more accurate calibration, fitting atmospheric corrections, was enhanced with new modes. It now handles observations with only two calibration sources when the target source lies along the line between them. An AIPS Memo on the other atmospheric modeling task DELZN was released. It describes the choices which must be made when planning high-accuracy experiments that will use DELZN.

- The master data sets used to test functioning and performance of standard AIPS tasks were updated. Changes in those tasks made the previous master data sets inaccurate. A HUGE test was added to handle new, faster computers.

- The new calibration source models provided with AIPS pointed out limitations in the modeling software which were corrected. The faster gridded modeling method is not accurate enough when very small images are involved and so is suppressed in such cases. Data weighted inversely by the square of the uncertainty can lead to failures in solutions for antenna gains. User control over the weighting was added to the calibration tasks.

- Miscellaneous changes included correcting the WENSS source catalog lists to eliminate "sources" which are the sum of separate components also appearing in the list, adding data computation display options to the interactive editing tasks TVFLG and SPFLG, and changing the method by which IMAGR chooses when to use the SDI method of Cleaning.

- In the first three quarters of 2004, 175 sites downloaded the 31DEC03 (frozen) version of AIPS and 623 downloaded the 31DEC04 (development) version. A total of 606 different sites (separate IP addresses) made some use of the AIPS cvs facility, either during installation of 31DEC04 or

running the "midnight job" to update their copy of 31DEC04. Overall, 997 different IP addresses appear in these three lists.

Goals for the Fourth Quarter 2004

1. Continue user support and bug fixes as the major portion of AIPS effort. Prepare and start the new release and AIPSLetter in December.
2. Test and implement binary distributions using the IBM Fortran compiler for Mac OS/X computers.
3. Provide support for pipeline data reduction, especially new automatic editing algorithms.
4. Begin investigations of new/improved imaging algorithms, including those dealing with spectral index and multiple pointings.
5. Begin to produce more source models to include with AIPS distributions.

AIPS++ (SSG)/ALMA CIPT Offline Subsystem

The key activity for this quarter was the execution of the ALMA Critical Design Review 2 (CDR 2), preparation for the ALMA TST1.1 (renamed from TST2), delivery of the SS8 release, and delivery of the prototype DataCapture process.

The main performance improvements this quarter were in the basic organization of the package (in preparation for the framework change) and focused development in support of mosaic data reduction.

A more detailed list of activities and achieved milestones is given below.

Key Developments

- SS7 release delivered; SS7.5 (patched version)
- SS8 release delivered;
- SS9 activity
- *http://projectoffice.aips2.nrao.edu/ss7.html*
  http://projectoffice.aips2.nrao.edu/ss8.html
  http://almasw.hq.eso.org/almasw/bin/view/OFFLINE/CurrentActivity

Highlights

- Presentations at the ALMA CDR2 are available at: *http://projectoffice.aips2.nrao.edu/almacdr2.html*
  The review was passed.
- Package library split
    - The package was split from four libraries with many inter-dependencies into 19 smaller, better-layered libraries without mutual dependencies. This will enable isolating smaller

sections of the code for use, improvements in binary sizes, link times, and facilitate the needed framework migration.
    - Effort on the namespace change proposal (to avoid conflicts in interactions with other user packages); to be concluded SS9.
- CFITSIO incorporated into the package; this replaced our custom FITS manipulation classes with this well-tested code and inherently enables large file support (FITS files larger than 2.1 GB).
- A simulator write of the ALMA Science Data Model to disk as needed for prototyping of the DataCapture process.
- Addition of a large mosaic dataset benchmark script; this will be installed on the ALMA benchmark page: *http://shiraz.drao.nrc.ca:8080/AlmaDRPBenchmarks*)
- Initial implementation of data selection proposal (to be concluded SS9)
- Initial implementation of general support for interpolation within the calibrater tool (to be concluded SS9)
- Data Capture Prototype
    - The prototype DataCapture process was developed. This process is at the nexus of the Control, Correlator, TelCal, Quicklook, and Archive subsystems, mapping the dataflow into the scientific data model. We achieved the needed data flow for the subset of the ASDM which was required for the R2 release. This was the first integration of the Offline subsystem with the main CIPT, and integration with the protocols established by the ITS group.

- ALMA TST1.1
    - The ALMA TST1.1 preparation took place throughout this quarter. Key preparations were modifications to the autoflag tool enabling more flexible restriction of data for flagging, consolidation of the required imaging facilities into a single tool to improve ease-of-use and robustness, and improvements in documentation to support a "standard" cookbook with entry points for scientists at different levels of acquaintance with the package. The test begins in October.

- Framework
    - Framework parameter/task elaboration. Initial goals set to host-level execution of a subset of tasks. Initial tasks based on AIPS five-year study of application use.

Goals for the Fourth Quarter 2004

1. Support of the ALMA TST1.1 mosaic test (Oct-Nov).
2. Refinement of the DataCapture process; attend ALMA All-hands meeting to work through final issues.
3. Initial development of the ALMA ASDM->MS filler.
4. SS9 development cycle
   - calibrater interpolation

- incremental calibration
- mosaic imaging performance improvements
- general imaging performance improvements (use of FFTW libraries)
- implementation of data selection interface
- initial implementation of ATM library for atmospheric calibration
- Re-implementation of code base documentation (doxygen)
- Single dish imaging improvements (de-striping algorithms)
- improvements in the single-dish/interferometric data combination

Archive

The NRAO Data Archive has been operational for 12 months and allows everyone on-line access to all VLA data and some VLBA data (*http://archive.nrao.edu/archive*). To date, over 550 users from 240 institutions have downloaded over 1 Tbyte of telescope data. The download data rate is about 100 Gbytes per month. Data files over one year old are in the public domain and accounted for one-half of the download volume. The data files reside on a hard disk array and provide the archive users with fast access and downloads via FTP and HTTP.

Currently the archive contains all VLA data going back to 1976, raw VLBA data going back to June 2002, and some calibrated VLBA data going back to December 2002. Efforts to expand the VLBA archive back to 1992 are underway. There is a small amount of GBT data available now from 2002 and 2003.

We are in the process of constructing and loading an archive mirror-site at the National Center for Supercomputing Applications (NCSA). Thus far 2.2 Tbytes of VLA archival data have been transported to NCSA. Our goal is to completely mirror the Socorro-AOC archive on a hard disk array at the NCSA by the end of 2004. We also intend to support user downloads from the NCSA mirror. This will take advantage of the NCSA high internet bandwidth, and substantially increase the download data rates available to our users.

Proposal Tool

The third quarter of 2004 saw several proposal tool releases. Each release was followed by intensive testing. Though currently the emphasis is on producing a working GBT proposal tool, the testers group represents all NRAO projects and instruments. The tool is designed to make adding support for other instruments and projects relatively straightforward.

The tool is now sufficiently robust that testing will be turned over soon to a GBT testers group, and it is our intention to have the tool functional for the February 2005 GBT proposal deadline.

For the fourth quarter we intend to further refine the tool based on feedback from the GBT testers. At the same time we are constructing an NRAO users database with which the proposal tool will interact.

Virtual Observatory

NRAO participates in the U.S. National Virtual Observatory (NVO) primarily in two areas: as a partner in developing the NVO and International Virtual Observatory (IVO) infrastructure and standards, and as a data provider, interfacing radio astronomy data and other resources to the VO.

Meetings

- NVO science advisory committee and team meeting (Aspen, July 27-30), J. Ulvestad, D. Tody attending. The focus of this meeting was planning for NVO applications to be released in early 2005, and planning for the NVO summer school scheduled for September.

- First NVO summer school (Aspen, September 12-17). D. Tody participated as a member of the faculty, presenting the VO image and spectral access protocols.

- International Virtual Observatory Archive (IVOA) fall workshop (Pune, September 23 – October 3). D. Tody participated as Chair of the Data Access Layer (DAL) working group.

Other Activities

Although not directly part of NVO, the NRAO end-to-end (E2E) project is vital to the eventual integration of NRAO into the virtual observatory. An NRAO-wide E2E Committee, co-chaired by W. Cotton and D. Tody, has been formed to coordinate development of a common dataflow and data management system for all NRAO telescopes. The scope of E2E includes proposal submission and observing through to data capture, production of raw data products for the archive, data quality control, pipeline and interactive data processing, development of an NRAO-wide archive, and publication of archival data to the VO, with integration of the dataflow through all these areas.

VO-related E2E work this past quarter included development of common observatory, project, observing, and science data models, and initial reviews of the overall data systems planned for EVLA, VLBA, and GBT. Much work has been done on the science data model (SDM) for archival data, mostly within the ALMA project and the science software group at the AOC. The intention is to have similar science data models for data from all NRAO telescopes, and for the high-level metadata in the science data model to be consistent with the metadata standards being developed for the VO.

Very Large Array and Very Long Baseline Array

Work is underway to replicate the NRAO archive to NCSA, with the first few Terabytes of data being transferred this past quarter. In addition to providing an off-site backup and high network bandwidth access to NRAO data, replication will provide access to NRAO data via the Teragrid for future experimentation with the use of Grid technology for large scale data access and computation.

Most of the directly VO-related work at NRAO has been on the general VO infrastructure, as part of the NVO and IVOA projects. Work continues with the data model group on dataset characterization, which is needed to characterize the physical attributes (spatial, temporal, spectral) of a dataset in a standard way, independent of the wavelength regime. Similar standards are being developed for dataset identification and provenance. This metadata is used for VO data access and also to characterize data in an archive.

Most VO data access effort has been on the simple spectral access (SSA) interface, used to access all tabular spectrophotometric data (spectra, time series, and SEDs). With the SSA data model in good shape at the start of the quarter, work has focused on data representation in FITS, VOTable, and native XML, and on the query interface. A general metadata extension mechanism for VOTable has been developed by an international team from the U.S., France, and Spain. We are working with the VO query language working group, which is led by the Japanese Virtual Observatory (JVO) who will also host the ALMA data in Japan, to integrate SQL-like query language capabilities into the data access interfaces. In the context of simple image access (SIA), we are starting to look at asynchronous services, needed for data access operations which require substantial time to compute the data to be returned. This work is being coordinated with the Grid and Web Services working group of the VO.

Work is underway to design a scalable execution framework for data access and analysis. Recent work has focused on the component-container architecture and the task-parameter model.

Central Development Laboratory

Central Development Laboratory (CDL) Highlights

Development of new low-noise amplifiers for the EVLA continues with good success, and amplifier production is keeping up with EVLA needs. The ALMA Band 6 receiver cartridge production serial #1 was completed. The ALMA local oscillator chains are meeting the requirements for phase noise, phase drift, sideband noise, and power output for Bands 3, 6, and 7; power output is low for Band 9. Design of a new 385-500 MHz SIS mixer is complete, and HEB mixers for 600-720 GHz were successfully tested. The ALMA correlator made excellent progress toward producing the first quadrant on schedule and under budget. The design of new feed systems for the EVLA and VLBA has produced prototypes showing excellent agreement with calculations and meeting the performance requirements. The first phase of the Green Bank Solar Radio Burst Spectrometer continues in regular operation for 20-70 MHz, and design work for the intended 10-3000 MHz range is making good progress.

Major Developments

Milestone	Original Date	Revised Date	Date Completed
Amplifier Design & Development:			
Evaluation of TRW Cryo-3 devices from the point of noise, signal and dc properties at cryogenic temperatures	04/01/04	10/01/04	
Design/redesign of cryogenic amplifiers using Cryo-3 TRW devices for EVLA, VLBA, GBT and ALMA covering frequency range from 1 to 120 GHz	04/01/04	4/01/05	
Superconducting Millimeter-Wave Mixer Development:			
Test Band 6 cartridge with production LO and bias supply	07/30/04		
Electromagnetic Support:			
Testing of EVLA C-Band prototype feed horn	09/30/03	08/31/04	08/13/04
Design of EVLA X-Band feed horn	12/31/03	07/30/04	07/30/04
Design of EVLA Ku-Band feed	09/30/04	12/31/04	
EVLA L-Band analysis	11/12/04		
GBT subreflector translation/tilt analysis	12/31/04		
Testing EVLA X-Band prototype feed horn	12/31/04		
ALMA Correlator:			
Complete VLBA data recording project	12/31/02	12/31/04	

Central Development Laboratory

Milestone	Original Date	Revised Date	Date Completed
Support system testing at the AOC as far as the correlator is concerned	03/31/04	ongoing	
Continue to receive and test production circuit cards	09/30/04	ongoing	
Receive first production bins and motherboards	09/30/04		09/30/04
Start assembling the first correlator quadrant	09/30/04		09/30/04
Release station/filter card test fixture documentation	09/30/04		08/31/04
Populate and start testing at least 1/2 of the production racks for the first quadrant of the ALMA correlator	12/31/04		
Start testing cable interfaces in the first correlator quadrant	12/31/04		
Finish motherboard PCB layout of a modified SCC test fixture	12/31/04		
ALMA Frequency Multipliers:			
Complete Band 6 frequency tripler evaluation set with actual driver amplifiers (in process)	12/15/03	10/15/04	
Complete Band 7 frequency tripler evaluation set with actual driver amplifiers (in process)	12/15/03	09/30/04	09/30/04
Band 6:			
Delivery of production waveguide blocks from machine shop	07/01/04	07/15/04	07/15/04
First batch of 13 units delivered to NRAO (Subsequently, 13 units every 15 days until all of the 139 units are delivered)	07/31/04	ongoing	4 x 13 = 52 delivered by 9/30/04
Band 7:			
Fabrication run (2 wafers, 50 devices each)	05/31/04	07/15/04	07/15/04
Delivery of production waveguide blocks from machine shop	07/01/04	07/15/04	07/15/04
First batch of 13 units delivered to NRAO (Subsequently, 13 units every 15 days until all of the 139 units are delivered)	07/31/04	ongoing	6 x 13 = 78 delivered by 09/30/04
Band 9:			
Prototyping complete. 3 units available for evaluation	09/15/04	11/15/04	

Milestone	Original Date	Revised Date	Date Completed
GB/SRBS Phase II:			
20-70 MHz, single polarization, inverted-vee dipole, analog spectrometer	11/30/04		
80-300 MHz, dual polarization, log-periodic on 45-foot, ETH spectrometer	11/30/04		
300-850 MHz, dual polarization, 45-foot telescope with log-periodic feed, ETH spectrometer	11/30/04		
GB/SRBS Phase III:			
10-80 MHz, dual polarization, four crossed dipoles, new digital spectrometer	09/30/05		
80-300 MHz, dual polarization, log-periodic on 45-foot, new digital spectrometer	09/30/05		
300-2500 MHz, dual polarization, 45-foot telescope with log-periodic feed, new digital spectrometer	09/30/05		

Amplifier Design and Development

Work continued on the development of amplifiers using devices from JPL/TRW Cryo-3 wafers. The electrical design of a balanced 2-4 GHz amplifier has been completed, and the mechanical design is proceeding. The design of a 4-8 GHz amplifier using NGST Cryo-3 devices is in progress.

An evaluation of the prototype 1-2 GHz balanced cryogenic amplifier with a high 1-dB gain compression point and relatively low noise has been completed. This amplifier is to be used as a post amplifier in the L-Band EVLA receiver. Five such amplifiers have been manufactured and delivered.

Final documentation for manufacturing the 1-2 GHz low-noise balanced amplifiers and the 1-2 GHz, high 1-dB compression point amplifiers has been prepared.

An effort was made to review several problem amplifiers covering the 12-18 GHz range. In a collaborative effort, one of these amplifiers was delivered to the Harvard-Smithsonian Center for Astrophysics for the evaluation of a very wide instantaneous bandwidth SIS mixer for the 360-410 GHz band. Given that we no longer have the 150-μm-wide HRL InP HFET's with which this amplifier was developed, an initial study was performed for the redesign of this amplifier with NGST Cryo-3 200-μm-wide devices.

Amplifier Production

Routine (non-developmental) amplifier production was focused on the Ka-Band with six Cryo-3 LNA's being produced and tested. Two 450 MHz amplifiers were completed for the Dynamic

Spectroscopy Group. Five Q-Band LNA's received device upgrades and were delivered to the GBT for use in the revised higher gain/warm mixer receiver configuration. Several amplifiers were repaired and returned to non-NRAO users.

Other Projects

During the quarter, the Chemistry Lab replaced the bright (non-bondable) gold bath. The previous bath had deteriorated over three years of use, meeting the manufacturer's expectation for bath longevity. The replacement bath cost approximately $4,000, and was used immediately to complete a large ALMA plating job (144 mixer body pieces) which would have cost an estimated $10-$12,000 if done commercially.

Superconducting Millimeter-Wave Mixer Development

ALMA Receiver Development

Band 6 mixer-preamps: During this quarter, 26 SIS mixer/preamps were assembled using mixer chips from UVA wafers #3, #4, and #5, and tested. Most of these mixers were used for evaluating wafers as they were delivered from the University of Virginia (UVA); we measure two each of the four different mixer circuits on each wafer.

It was found that the mixer-preamps were very sensitive to source mismatch, with the result that when connected to the less well-matched port of the OMT, the image rejection was reduced significantly at some intermediate frequencies. This effect is predicted theoretically and is due to the low conversion loss between upper- and lower-sidebands in the original mixer-preamps. The inter-sideband conversion can be reduced by reducing the IF load impedance seen by the SIS mixer. A modified IF interstage network was designed to accomplish this.

We suffered our first failure of a 4 K GM refrigerator (Sumitomo SRDK-415E) this quarter when a retaining pin in the displacer came loose and jammed the displacer drive. Replacement was complicated by small differences in mounting hole locations on the original refrigerator and its replacement.

We now have seven mixer-preamps deemed suitable for use in Band 6 cartridges—four are already in the prototype cartridge and production cartridge #1. J&E Precision Tool Co. is completing an initial production run of 20 mixers. Wafer 6 has been delivered by the UVA and will be tested in the next quarter.

Band 6 cartridge: The first production cartridge assembly has been completed and is currently being tested in the Cartridge Test System (CTS). Considerable time was spent this quarter on careful documentation of all cartridge test equipment and assembly procedures.

It was found that the G10 spacer sections on the first production cartridge required inverting and rotating to align their access holes with internal components. A series of mechanical measurements confirm that no significant changes occur in the parallelism and concentricity of the thermal stages.

A manually-operated beam pattern measuring system was constructed for verifying the beam shape and pointing of cartridges mounted in the CTS.

Measurements were made of the gain stability of the prototype cartridge. This gain stability data, measured in the CTS, shows an improvement by a factor of a few compared with earlier measurements made in the mixer test system—probably a result of using a phase-locked LO and more stable warm IF stages in the CTS.

Construction of a 4 K test system for measuring the ALMA Band 3 and Band 6 OMT's with a VNA was continued this quarter.

4-12 GHz preamplifier production: An agreement has been made with JPL for the acquisition of HFET's from the Cryo-3 wafer. This will provide the transistors needed to complete all the Band 6 preamplifiers.

We are working with the preamp manufacturer, ACC, Inc., who is manufacturing the initial batch of 24 preamplifiers to our design. They will deliver the first four preamps shortly. To test the preamplifiers and select pairs matched in gain and phase, as required for the sideband-separating mixers, the amplifier test system is being refurbished: a PC replaces the old Apple II, and new software will permit measurement of phase in addition to gain and noise temperature.

Non-ALMA Millimeter-Wave Development

385-500 GHz SIS mixer: A complete redesign of the 385-500 GHz mixer circuit has been carried out in this quarter. The new design uses UVA's new 3-μm SoI (Silicon on Insulator) substrate technology which offers several advantages over the old 7-μm SoI process. The 3-μm substrate is more transparent than the 7-μm substrate, making it easier to align the features on the back of the substrate with the pattern on the front, and requires a shorter RIE etch time to define the final chip size. A new fabrication process, which adds an additional 500-nm SiO_x insulation layer and a 600-nm ground plane, has also been developed. It is now possible to fabricate a series SIS array in a microstrip configuration with low characteristic impedance which significantly reduces the self inductance of the array. This allows us to use a mixer circuit similar to those used in ALMA Band 3 (84-116 GHz) and Band 6 (211-275 GHz) for the 385-500 GHz band. The circuit design has now been completed. Mask layout and mixer block design will begin in the next quarter. This is a joint R&D project between NRAO and UVA, and is supported mainly by a NSF grant to UVA.

Central Development Laboratory

350-μm receiver technology development: The 350-μm atmospheric window (780-950 GHz) is important for the next generation of terrestrial radio telescopes as well as for satellite instruments. At present, no heterodyne receivers for this band can achieve the nearly quantum-limited sensitivity of niobium SIS receivers below ~ 600 GHz. The CDL is therefore proposing to develop the technology for quantum-limited receivers in this band. The goal is to produce reliable, inexpensive, quantum-limited receivers using recently-developed SIS mixer fabrication technology. The mixers will be designed to support a wide IF bandwidth, which is desirable for both spectral line and continuum measurements, and in a form suitable for sideband-separating and balanced mixers. Success in this work will put NRAO in a strong position to bid on the ALMA Band 10 receiver production.

Investigation of Beamlead HEB Mixers for Heterodyne THz Biohazard Detection

This is a SGER (Small Grant for Exploratory Research) awarded by the NSF under the ACT (Approaches to Combat Terrorism) program. This is a one-year grant to build, measure, and compare different types of beamlead HEB mixers in a 600-720 GHz receiver using existing NRAO equipment. Cryogenic measurements of the phonon-cooled HEB mixer have been made showing the expected superconducting transition.

During the summer, an NSF Research Experiences for Undergraduates (REU) student outfitted a cryostat for 600-720 GHz receiver measurements. Figure 1 shows an overhead view of the cryostat with the Martin-Puplett interferometer for LO injection beside the dewar. The LO is supplied by a WR-8 Gunn oscillator plus quintupler borrowed from the ALMA project. A tunable YIG-type LO of ALMA Band 9 type is being built for future measurements.

The phonon-cooled HEB was measured in this receiver. The measured receiver noise is plotted in Figure 2. The noise of the IF portion of the receiver was measured separately and removed from this plot by calculation. The loss of the optics is unknown and therefore is not subtracted from the measurement. The plot represents the noise of the HEB mixer multiplied by the loss of the optics in front of the mixer. Likewise, in Figure 3, the measured conversion loss includes both the mixer conversion loss and the optics loss. Note that the Rayleigh-Jeans approximation is not used in these calculations. The REU student also developed the measurement software in LabView.

A diffusion-cooled HEB mixer has been assembled in the same mixer block design and will be measured shortly with the same receiver for comparison. After this measurement, the receiver will be modified to both improve the optics and incorporate the electronically-tunable YIG LO of ALMA Band 9 design.

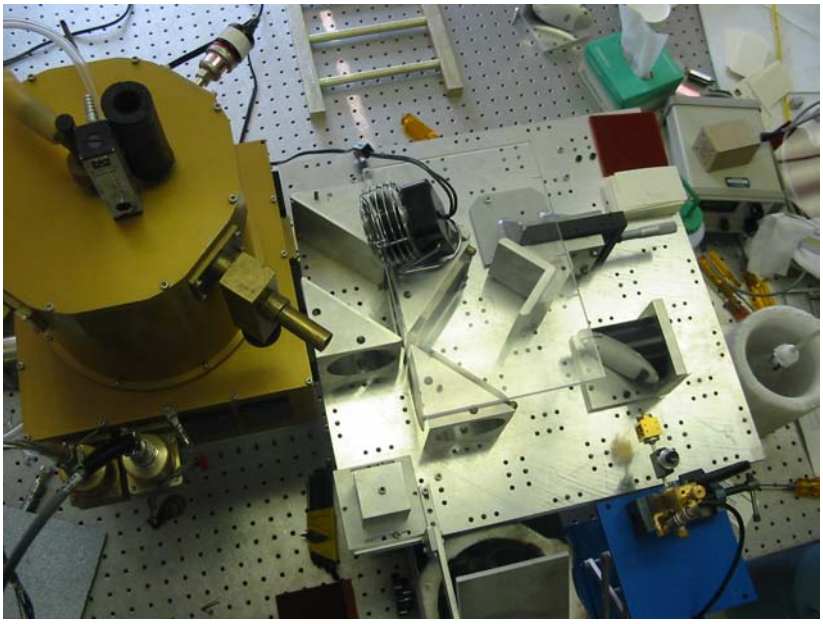

Figure 1. Photograph of 600-720 GHz HEB measurement setup showing cryostat on left and Martin-Puplett interferometer for LO injection on right.

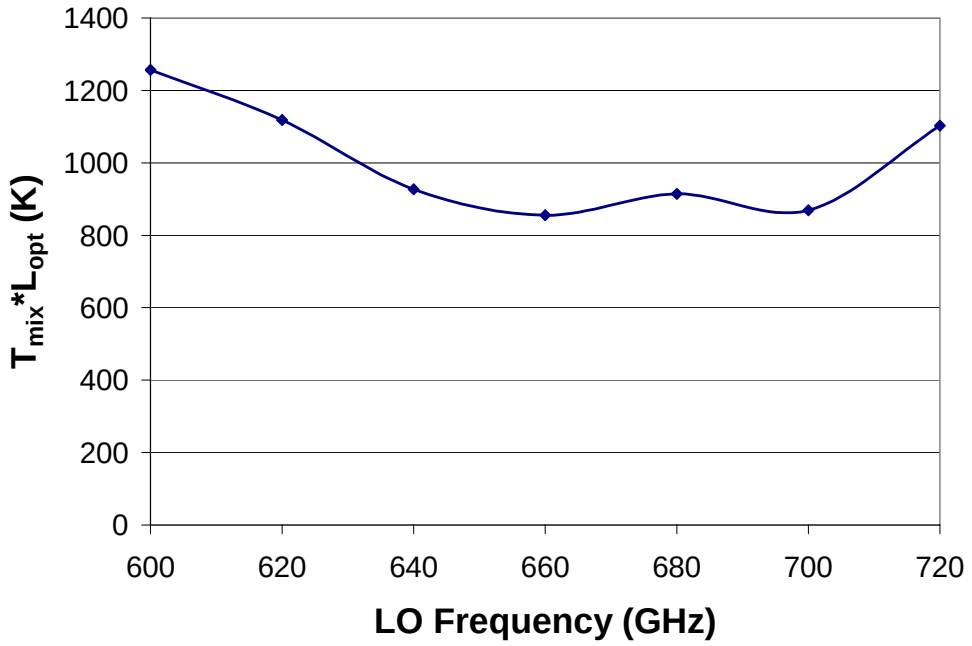

Figure 2. Measured receiver noise temperature multiplied by optics loss of phonon-cooled HEB mixer.

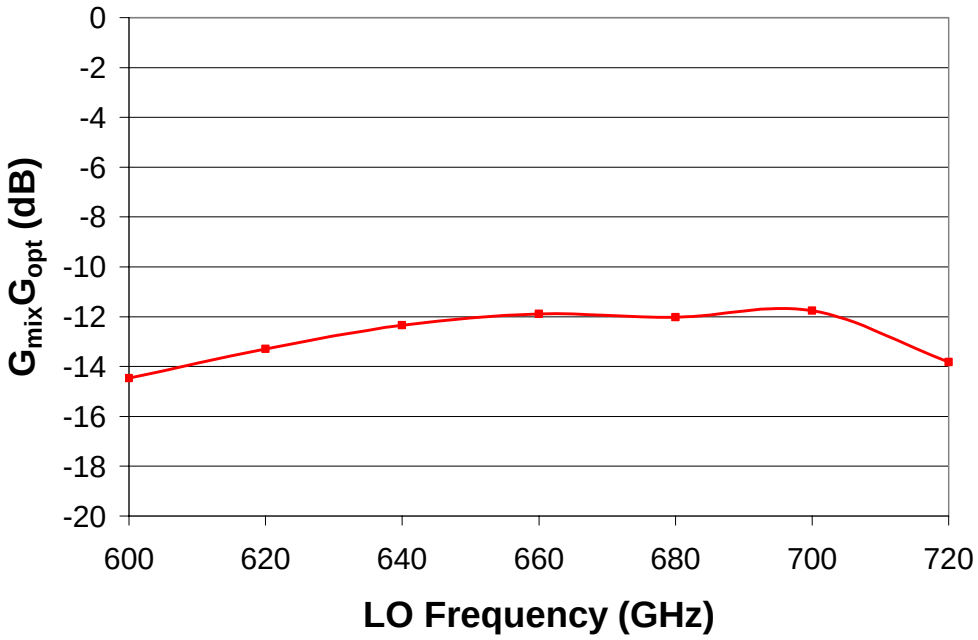

Figure 3. Measured conversion loss of phonon-cooled HEB mixer, including loss due to optics in front of mixer.

Electromagnetic Support

EVLA

A detailed design of the X-Band (8-12 GHz) feed was completed. The feed has an illumination taper of -14 dB at the edge of the subreflector. The cross-polarized sidelobes are lower than -26 dB. Return loss of the feed is better than -30 dB.

A prototype of the C-Band (4-8 GHz) feed was fabricated and measured. Far-field patterns of the feed were measured in a new compact range at MIT-Lincoln Laboratory. The feed has an average illumination taper of -13 dB at the edge of the subreflector in the given band. The patterns show good circular symmetry and agree very well with theory. The cross-polar patterns in the 45-degree plane are below the -25 dB level.

A study, using measured far-field and near-field patterns of the L-Band feed, is in progress to calculate the efficiency and spillover temperature to compare with measured results on the VLA antenna.

Central Development Laboratory

Spectrometers/Correlators

ALMA Correlator

Construction and testing of the first quadrant of the ALMA correlator began last quarter. One production station bin and one production correlator bin have been assembled, populated with production printed circuit cards, and successfully tested. Bins and motherboards for one complete production station rack and one complete correlator rack have been installed.

A commercial power supply rack was modified and installed in the first correlator quadrant.

Bids for the system data cables were received and evaluated, and a purchase order was placed in late September.

Approximately 250 assembled production circuit cards of various types for the ALMA correlator were received and successfully tested during the quarter.

A design of the clock distribution system for the ALMA correlator was completed, and parts for the evaluation of prototypes placed on order.

A new design for the final adder PCB for the ALMA correlator was started and is about 50 percent complete.

The second of three station/filter card test fixtures, completed and tested during the previous quarter, was delivered to Europe. All documentation for the test fixture was completed and released on the ALMA EDM website.

VLBA

Design work on the VLBA data translation project was completed, and a VLBA experiment was successfully translated in late September. The only work left on this project will be low-level operational support as needed.

GBT Spectrometer

Several new Xilinx FPGA personalities for the GBT spectrometer spigot card were designed to support 27 new 200 MHz bandwidth modes. These modes were successfully tested in September. New 8-bit, 2048-lag modes were also provided and tested.

Central Development Laboratory

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 currently being developed and evaluated. The status of the cooled frequency multipliers for the various ALMA frequency bands in the baseline plan is described, followed by an outline of other frequency multiplier development efforts.

A brief summary of the activity in this quarter is given, and reference to detailed reports provided as appropriate.

Band 3: No cooled frequency multiplier stage is required for this ALMA band.

Band 6 and Band 7: As reported earlier, Virginia Diodes, Inc. (VDI) was awarded the contract to supply the frequency triplers to meet the full ALMA first LO requirement (all 64 antennae, plus ten percent spare units.) So far, progress has been fairly close to meeting the schedule. See ALMA EDM document number FEND-40.10.00.00-027-A-MIN for details.

Delivery of the frequency multipliers, scheduled to start around July 31, 2004, was delayed by a few weeks. Several batches of frequency multipliers have since been delivered and, at the current rate of delivery, the original completion date of December 31, 2004 is quite likely to be met. So far, four batches (13 units each) of Band 6 and six batches (again, 13 units each) of Band 7 frequency triplers have been delivered. Cryogenic evaluation of sample units, prior to the acceptance of all of the above batches, is in progress.

Band 9: As described in earlier reports, the Band 9 frequency quintupler development contract with VDI was modified to support the development of an integrated version of the frequency doubler-tripler cascade and the supply of three such units for use in the Band 9 LO instead. This was done after a cascade of frequency doubler, followed by a frequency tripler driven by a Band 7 LO driver, was evaluated at the NTC, yielding encouraging results as described in ALMA EDM document number FEND-40-10.00.00-027-A-REP.

Tests on the first iteration of the integrated frequency sextupler units failed to yield output power comparable to that obtained from the discrete frequency doubler-tripler cascade described above. However, active development work is under way; further results should be available in 2–4 weeks. See FEND-40.10.00.00-043-A-REP for further technical details.

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.

The first pre-production Band 3 LO driver was delivered to HIA. Some of the test data is shown in Figures 4-6. The Band 3 cartridge group was able to use and phase-lock the LO with no problems. Further measurements integrated with the first pre-production Band 3 cartridge are in progress. A complete package of documentation was prepared for this first deliverable, including technical specifications, acceptance procedures, verification plan, compliance matrix, and acceptance report. These documents are in final IPT acceptance and will serve as templates for documentation for other bands. The second Band 3 warm cartridge assembly (WCA) has been assembled and is currently being tested. Delivery is scheduled for the end of October 2004.

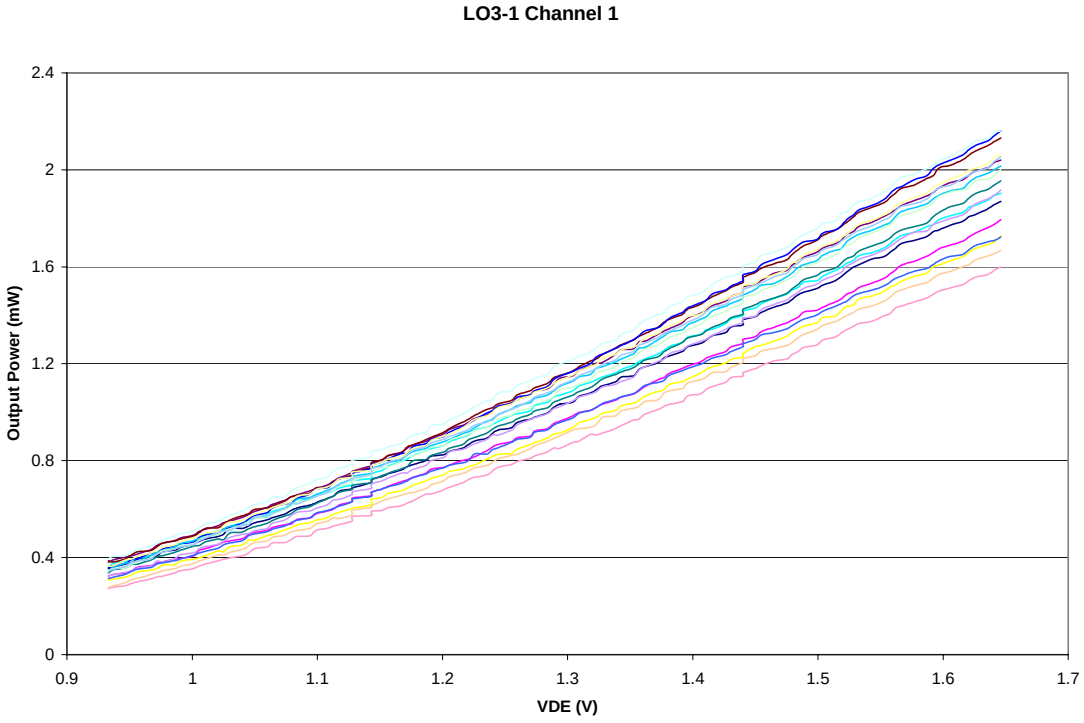

Figure 4. Measured output power vs. AMC amplifier drain voltage at the output of channel 1. Each trace represents a different frequency with 17 traces total, one every 1.0 GHz across the specified band. This plot verifies that the output power in this channel can be adjusted to produce a minimum of 0.4 mW and a maximum of 1.6 mW over the specified frequency band.

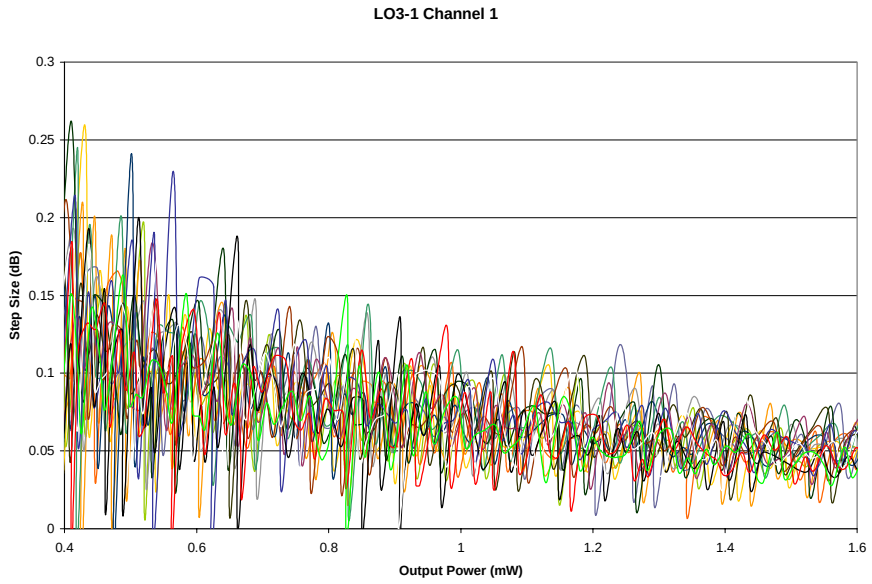

Figure 5. Channel 1: Measured P_{out} (power setting n) minus P_{out} (power setting n+1) vs. P_{out} (power setting n). This plot verifies that the output power of this channel can be adjusted over the full specified output power range with step sizes less than the minimum 0.3 dB specification.

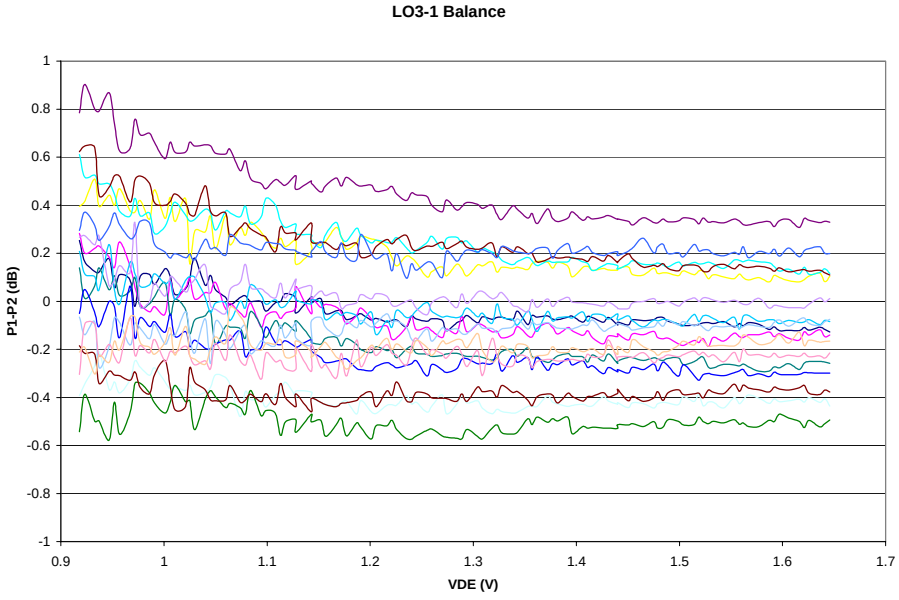

Figure 6. Measured P_{out} (channel 2) minus P_{out} (channel 1) vs. AMC amplifier bias. This plot verifies that the balance between the output power of channels 1 and 2 is better than the 1.3 dB specification over the full range of frequencies and output power.

Central Development Laboratory

The first pre-production Band 7 LO driver was completed and delivered to IRAM. After delivery, a week was spent at IRAM in support of integration and testing. The LO was tested with their mixer test dewar since their first pre-production cartridge has not yet been assembled. Initial tests were encouraging and the LO is fully functional including phase-locking. Amplitude stability of the complete receiver was measured with results in 1-2 x 10^{-4} range, within ALMA specifications. Figure 7 shows a photograph of the serial #1 Band 7 LO integrated with the mixer test dewar at IRAM.

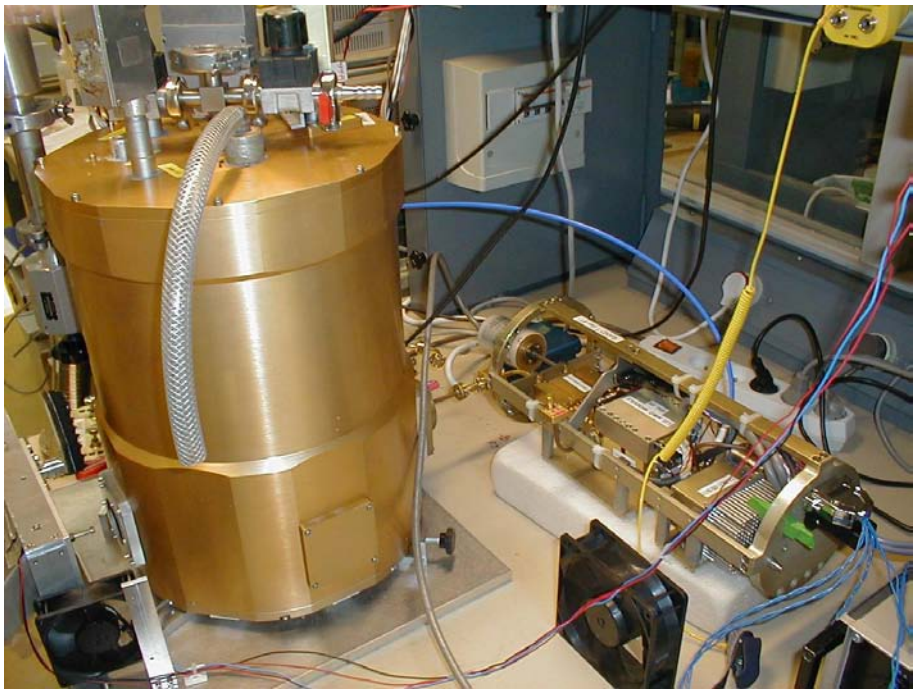

Figure 7. Photograph of first Band 7 pre-production LO integrated with a mixer test dewar at IRAM.

The Band 9 pre-prototype LO plate was shipped to SRON using a prototype doubler and tripler instead of quintupler. Virginia Diodes, Inc. (VDI) is currently working on integrating the doubler and tripler into a single cryogenic sextupler block with the same footprint as the original quintupler. The first pre-production Band 9 LO is currently being assembled and will be tested and delivered this upcoming quarter.

Central Development Laboratory

Green Bank Solar Radio Burst Spectrometer (GB/SRBS)

In June 2003, the NRAO received an NSF MRI grant to develop a high performance instrument to receive solar radio emissions with adequate temporal and spectral resolution to probe a wide variety of active solar phenomena from the base of the corona, including energy released from flares, particle acceleration, and escape, coronal shocks, and electron beams. The instrument consists of two radio spectrometers that will together provide frequency coverage from 10-2500 MHz. This instrument provides a basic research tool in solar radiophysics for use by the wider community, remedies the lack of an important component of the U.S. Space Weather effort, and provides a platform for research and development work on broadband antennas, feeds, and receivers needed for the upcoming Frequency Agile Solar Radiotelescope (FASR) project. A significant portion of the development work will be performed at the NRAO Technology Center (NTC) in Charlottesville.

Solar activity continues to be monitored over the 20-70 MHz band by GB/SRBS Phase I with excellent reliability. The data products are made available to the solar research community from the dedicated SRBS server in Charlottesville.

Work continues on the upgrade to extend the frequency coverage. Although the 45-foot radio telescope is ready for routine operation, the original motor drive control system will be upgraded later this year to enhance reliability. The hardware implementation plans for the various bands continue to evolve to improve sensitivity and resolution of the overall system. Two log-periodic, dual-polarized antennas are currently being constructed to cover the 80-300 MHz and 300-2500 MHz bands. The high frequency antenna will serve as a feed for the 45-foot telescope, while the lower frequency model will be mounted (pointing upward) at the top of the 45-foot's feed arms. The low-noise, high dynamic range active balun for the lower band has been fabricated and demonstrates very good performance. A similar active balun which uses SiGe MMIC's is currently under construction for the higher band.

An REU student intern completed the proof-of-concept work on the new digital spectrometer for the Phase III upgrade. This unit, operating over the 30-350 MHz band, has demonstrated good spectral purity and adequate frequency resolution for SRBS applications. A prototype version of the frequency converter is currently being designed, with fabrication and evaluated schedules for next quarter. The design of a similar unit for the 300-2500 MHz band is currently under way.

Computing and Information Services

Computing and Information Services (CIS) Highlights

During this quarter, the NRAO Computing Security Committee collaborated with their counterparts at the European Southern Observatory (ESO) to explore and resolve the issues of computer and network security for the ALMA project. The security section of an operations plan for ALMA was drafted. As a result of focused attention on security by CIS personnel, the NRAO continues to be almost entirely spared from major virus outbreaks. Improved user education has also contributed to this success.

The Common Computing Environment (CCE) group has decided on the path forward for Linux computer support, adopting RedHat Enterprise Linux.

The second NRAO public wiki or web-based collaborative platform was made available this quarter. Unlike the original NRAO wiki, which was restricted to use by systems on the Observatory's Intranet, this wiki is accessible from anywhere on the Internet. Significant collaboration is already occurring on this platform between NRAO staff and personnel at external institutions, such as the European Southern Observatory (ESO).

A "Beowulf" cluster of powerful, rack-mounted Linux servers has been bid to satisfy the requirements of Charlottesville scientific staff for pulsar data reduction. This is the first such cluster (eight processors plus a master node) that will be operated by the Observatory.

Improvements to the Observatory's computing environment funded by CIS this quarter included a new file server in Green Bank, a new Mac OS/X processing computer in Charlottesville, and new servers for the VLA site and the Green Bank Science Center.

The work required to build the phone and network infrastructure within the Observatory's new Edgemont Road (Stone Hall) facilities in Charlottesville commenced this quarter and will continue through next quarter as these facilities are occupied by the NRAO in January 2005.

As a result of lower costs for our Intranet contract with AT&T, funds have become available to upgrade service at four VLBA sites and an upgrade to T1 (1.544 Mbps) access has been completed at Hancock and Owens Valley.

A concerted effort was made to migrate staff at the NRAO Technology Center (NTC) to Windows XP and enter them in the Active Directory (AD) domain. This work has been successfully completed and has already eased the burden on the Observatory's Charlottesville Windows support staff.

Computing and Information Services

Last quarter, there was a complete review of CIS operations. Recommendations of the review are gradually being implemented. Among these is the effort to add a second communications engineer to support the present operations and to plan for growth. Recruiting is in progress.

Although we did not receive a final budget allocation until this quarter, CIS was able to make some significant contributions to improve the computing environment at the observatory. Clearly we need modern computers for individual use, and we would prefer to have an environment where no personal workstation is more than four years old. We were able to fund upgrades such that most staff will have a computer that is six years old or less. Other major initiatives included: addition of data storage to the data archive in New Mexico for VLA, VLBA, and GBT data; a new file server in Green Bank; a new Mac OS/X data processing computer in Charlottesville; new servers for the VLA site and the Green Bank Science Center; and a replacement Ethernet switch for GBT operation.

Central Computing Services

Milestone	Original Deadline	Revised Deadline	Date Completed
CCE: Determine future Linux plans	06/30/04	09/30/04	09/21/04
Purchase "spyware" blocker and excisor	09/30/04		09/24/04
Personal firewall on all Linux systems	03/31/04	09/30/04	09/30/04
Use encrypted IMAP/POP3 only from Internet	10/04/04		
Resolve remaining AD errors	10/31/04		
Update Computing Security Policy	02/05/01	11/30/04	
Acquire RedHat Enterprise Linux campus license	11/30/04		
Test authentication of VPN concentrators from AD	11/30/04		
Use LDAP for Linux authentication	11/30/04		
Personal firewall on all Windows systems	05/31/04	12/31/04	
Deploy "spyware" blocker on all Windows systems	12/31/04		
CCE: End AD production client migration	12/31/04		

Security

The threat of "ad-ware," "spyware," and "malware" on the NRAO's Windows desktop systems has been addressed by the purchase of an Observatory-wide license for a commercial product designed to combat such threats. The actual deployment will occur in the next quarter. In addition, a NRAO-wide educational presentation was given on the general topic of computer and network security, and the notes made available for all employees.

The issue of user education was also considered by the NRAO Computing Security Committee in this quarter. Some promising web-based technologies are being investigated to allow us to improve communication of vital security information to all NRAO employees.

While other institutions have adopted a mandatory laptop inspection protocol, the committee reached a consensus on a suitable alternative that will achieve the same goals. Each NRAO site will now set up a "quarantine" virtual network for visitor systems, and modify existing infrastructure (DHCP and DNS servers) and where necessary wiring and routers, to implement such a network. Work on this in Charlottesville is contingent on the significant re-wiring effort associated with the anticipated building extension completion.

One of the last areas where user passwords might be sent over the Internet "in the clear," the use of unencrypted IMAP and POP3 protocols to read incoming NRAO e-mail from the general Internet, is being eliminated. As of October 4, 2004, the NRAO's routers will be configured to block all use of unencrypted POP3 and IMAP mail protocols from the Internet. The encrypted (SSL) forms of these protocols have been widely available and in use for years, and given that all it takes to engage them is usually a single check box in the mail program's configuration, this imposes almost no burden on our users. Unencrypted IMAP/POP3 will still be possible at some sites from within the NRAO intranet, but we anticipate this will be phased out by the individual sites in the coming year.

During this quarter, committee staff members collaborated with their European Southern Observatory (ESO) counterparts to explore computer and network security for the ALMA project. Draft wording for the security section of an operations plan for ALMA was contributed.

Two computing/network security incidents occurred during the quarter:

1) A system in Tucson was infected with an e-mail based "zero-day" virus (i.e., one that starts propagating before the anti-virus companies have a defense against it), delivered via e-mail. The virus then propagated to two other systems in Green Bank. Shortly thereafter, all NRAO e-mail gateway systems received a definition for the virus in question; and the definition was automatically put into force. While the virus attempted to spread rapidly through the NRAO via internal mailing lists, almost all employees had the foresight not to click on the infected attachment. As a result, only three systems were affected, and these were rapidly cleaned by systems personnel at the two affected sites. The issue has been resolved. Our internal mailing lists are now "moderated" to prevent this sort of unwanted propagation, and the closure of outgoing mail except through the NRAO's four primary mail servers further prevents the spread of such a virus.

2) An employee in Charlottesville noticed what appeared to be live viruses "leaking through" the Sophos-based mail scanner on the NRAO's mail gateway machines. As the employee ran Linux, there was no threat to that particular system. A thorough investigation revealed a configuration

change brought about through a software upgrade to our mail gateway systems; as a result, messages buried in several layers of zip archives were leaking through. The configuration parameter to prevent this was promptly corrected, resolving the issue.

Common Computing Environment (CCE)

The operational phase of the Common Computing Environment became fully active during this quarter; the accelerated phase of the project was completed last quarter.

The migration from the existing NT 4.0 domain to the Active Directory (AD) domain has been the main focus of the Windows administrators for the past few months. We have been working diligently to ensure the AD domain is working properly, and to move our users into the domain as soon as possible. While all of the users and groups that were members of the NT 4.0 domain were copied to the AD domain at one time, each user's computer is being migrated individually. While this process of one-by-one migration takes more time, it provides an opportunity for site administrators to discuss the benefits and new features of AD. We are now at a point where all new user accounts are created in the AD domain and old NT accounts are disabled once the desktop migration is complete. Even though we are giving each user one-on-one attention, a document was recently sent to NRAO staff outlining the benefits and features that would be available to users in the new domain environment. With the continued diligence of the Windows administrators we plan to complete the domain migration by the end of the year.

One of our primary goals from last quarter was to upgrade the AD domain controllers to Windows Server 2003. Unfortunately, the upgrades were not without problems. At this time, most of these issues have been identified and rectified. Even though some minor issues remain, none of them are serious enough to halt the migration process.

The release of Service Pack 2 (SP2) for Windows XP has been of particular interest to the NRAO Windows administrators recently. Initial reports from Internet users that installed SP2 were a little discouraging, as there seemed to be a myriad of serious problems as a result of applying the service pack. To minimize the negative impact of installing SP2 on NRAO computers, the service pack has been tested on a variety of computers. This testing will be complete during the next quarter and NRAO-wide deployment will follow shortly thereafter.

Service Pack 2 is a patch which fixes bugs in Windows XP, and adds extra functionality to the XP operating system and associated applications. One of the most beneficial features of the service pack is added functionality of the Windows integrated Firewall. This firewall is an IPv6 firewall and is enabled by default on all network connections. This firewall will be instrumental in protection of our computers , especially laptops carried with travelers and then connected to foreign networks.

Computing and Information Services

Application deployment has greatly reduced the amount of time administrators spend installing applications and patches on Windows systems. The recent jpeg vulnerability was easily thwarted by patching vulnerable applications centrally and pushing the updates to client desktop machines. "Ad-Aware" is a new addition to our standard desktop applications which has been very useful. It is an excellent front-line defense in preventing the installation of spy-ware and pop-ups on NRAO machines.

After much discussion among all NRAO systems administrators, the principal "stakeholders" in the issue at all NRAO sites, and our colleagues at sister institutions such as ESO, the decision on a standard Linux distribution for NRAO has been made. It is our recommendation that the CIS division purchase a "campus" educational license for NRAO from RedHat. This license is based on the number of FTE's and not the number of processors, and the minimum FTE number is 1000. It also permits us to install any version of RedHat Enterprise Linux (RHEL) on as many computers as needed. This flavor of license will be particularly relevant as NRAO starts to use cluster technology for advanced computing needs in the coming years.

It is also our recommendation that NRAO and its various projects and divisions adopt the following strategy:

- Migrate to RedHat Enterprise Linux (RHEL) on all official NRAO Linux-based desktops, laptops and servers; the timescale for this will be set by the CCE-Unix group, in consultation with the primary stakeholders (ALMA, AIPS++, AIPS, etc).

- Provide copies of RHEL to employees for home use as needed (media only; the license permits this).

- Mention RHEL or White Box when asked by our colleagues in the astronomical community which Linux distribution we use and/or recommend (White Box is a clean built-from-free-source copy of RedHat Enterprise Linux, provided by a small network of volunteers).

Plans to purchase this license are in place, and we expect to sign a contract in the next quarter.

Given that NRAO already pays for one (and soon two) licenses for RHEL Advanced Server to operate Oracle database services, and that the incremental cost between these and a full, 1000-person campus license for RHEL is negligible, the decision is likely to save NRAO a non-trivial amount in licensing over the next few years.

The implementation of personal firewalls (IPTables or "Netfilter") on Linux has been achieved on all systems used as personal workstations or laptops. We will be extending this goal to insert customized, carefully crafted IPTables rules on our servers as appropriate in the upcoming two quarters.

Computing and Information Services

The use of openLDAP servers for authentication continues to be investigated and tested in various configurations. We have set an ambitious target of November 30 for having our Linux clients use openLDAP for authentication in place of the existing legacy NIS authentication inherited from the days when our network was dominated by Sun systems. The initial testing indicates it may be possible to keep to this aggressive schedule.

Finally, the work of ensuring that our services are correctly and fully documented, both for end users and for information sharing among system administrators, continues. Good progress was made in this last quarter, in particular on the systems front.

Web Infrastructure

Milestones	Original Date	Revised Date	Date Completed
Provide second public "wiki"	07/31/04		07/31/04
Design of Next Generation Web Services	11/30/04		
Evaluate additional Groupware	04/01/04	12/31/04	
Purchase proxy servers for VLA	06/05/03	12/31/04	
Test RHEL server with NRAO web configuration	12/31/04		
Investigate stopgap web calendaring	12/31/04		
Instant Messaging Server Pilot Project	12/31/04		
Deploy Next Generation Web Services	07/01/05		

The web proxy for the NRAO Technology Center (NTC) mentioned in the previous report is now operational. The proxy planned for the VLA site has been pushed out to the end of the calendar year, mainly due to higher priorities in New Mexico.

The second "public" wiki, or web-based collaborative platform, for NRAO was made available in this quarter. Unlike the original NRAO wiki which was restricted to use by systems on NRAO's Intranet, this second wiki, or "wikio," is accessible from anywhere on the Internet. There is already significant collaboration occurring on this platform between NRAO staff and their counterparts at sister institutions such as ESO.

Despite considerable effort, the attempt to migrate the web-based Calendar Publication service (WebEvent) from the Tucson web server to Charlottesville was not successful. The vendor of the software has been unable to provide a solution to serious timezone-related defects unearthed by the migration attempt, and as a result this service has been left on the Tucson server on a temporary basis.

Computing and Information Services

A re-ordering of Program Office Management priorities has resulted in their scheduling the test and evaluation of web-based calendering to late in 2006 and not late 2004 as originally anticipated. As a result of this, the flaws in NRAO's existing web-based WebEvent scheduling/calendar system, and the need to migrate the latter service from the Tucson web server sooner than 2006, alternative strategies are being investigated by the web administration group.

After initial discussion, the group has arrived at a conceptual plan for the next generation of NRAO web services, and a detailed design document will be produced this coming quarter. It is anticipated that this design will be put into effect on or around the beginning of the third quarter of 2005.

Finally, the availability and use of Instant Messaging services by several staff members has not gone unnoticed. Such services, when they rely on commercial servers operated by AOL, Yahoo, MSN, etc. can be a very significant and serious source of "malware." Thus, it is highly desirable for NRAO to provide its own internal service to satisfy this need. To that end, technology such as the open source Jabber server will be investigated by the group with a view to making a small network of such servers (one per site) so that staff can more easily communicate. It is anticipated that a little effort and documentation in this area may have a large payoff in productivity.

Charlottesville Computing

Milestones	Original Date	Revised Date	Date Completed
Upgrade Linux servers to RedHat 9	04/30/04	07/31/04	08/31/04
Mailing list software version upgrade	07/31/04	09/15/04	09/15/04
Populate inventory database	05/15/04	09/30/04	09/30/04
Migrate Tacacs authentication	06/30/04	10/31/04	
Upgrade Windows systems to Windows XP	06/30/03	11/30/04	

Work on creating the necessary phone and network infrastructure within the new Edgemont Road (Stone Hall) building has commenced and will be ongoing until after the anticipated move-in date of January 2005. There will be significant computer and phone relocations necessary in the coming two quarters associated with this and the closing of the Old Ivy Commons temporary quarters for the Observatory Business and Human Resources divisions.

All servers except for the production NRAO web servers have now been upgraded to the RedHat 9 operating system. This necessitated some operational changes in the "Classic AIPS" infrastructure in Charlottesville that enables routine data reduction and analysis of interferometry data by local scientific staff.

Computing and Information Services

A concerted effort was made to migrate staff at the NRAO Technology Center (NTC) to Windows XP and enter them in the Active Directory (AD) domain. This has proven successful and is already easing the burden of Windows support on our staff.

Because of more pressing CCE and Security tasks, work on migrating the "tacacs" (modem authentication) service from a legacy SPARCstation "server" to a modern Linux rack-mounted server has been delayed. It is expected that this target will receive more attention next quarter; the software is in place and all that remains is testing with the appropriate Cisco modem concentrator.

The upgrade of the mailing list "mailman" software proceeded smoothly. The enhanced features made available to list owners have already proven to be extremely useful.

A stopgap measure in the form of a simple spreadsheet has been used to create and maintain an inventory of all computer systems in Charlottesville. The Track-it database has, as mentioned in the previous report, proven problematic, and the scripts to replace its functionality were not quite ready in time for the year-end ordering of desktop and laptop upgrades.

Finally, a "Beowulf" cluster of powerful rack-mounted Linux servers has been bid to satisfy the requirements of pulsar data reduction by local scientific staff. A grant was obtained to pay for the hardware. Although small by industry standards (8 processors plus a master node), this is the first such cluster at the NRAO that will be owned and operated by the Observatory.

Observatory-wide Communications

Milestones	Original Date	Revised Date	Date Completed
Complete communication wiring for new Stone Hall areas	08/31/04		08/31/04
Order network equipment for completed Stone Hall	08/31/04		08/31/04
Move external network connections to Stone Hall	10/31/04		
Add video conference unit in AOC West	08/31/04	11/30/04	
Upgrade network services to VLBA SC antenna	09/30/04	11/30/04	
Complete network upgrade in Stone Hall	11/30/04		

The major effort in communications has been the cabling of the addition of Stone Hall for networking and telephony. The contractor gave us permission to begin pulling the cables in June. The first phase, to wire the newly constructed areas, is complete. Since the completed building will have the main communications room in a different, more central, location, all cabling from the existing rooms must be run to the new location. In addition, all external services must be relocated. This includes the network and communication connections for phone service, the intranet connections, and Old Ivy

Computing and Information Services

Commons plus dedicated connections to Green Bank, the NRAO Technology Center, and the University of Virginia. These moves will be done early next quarter. A new Ethernet switch will provide Local Area Network services to the building. This should all be complete well in advance of the building occupancy.

As a result of lower costs for our intranet contract with AT&T, we upgraded the service at four VLBA antenna sites. The upgrade to T1 (1.544 Mbps) access was completed at two of the sites (Hancock and Owens Valley). It now seems unlikely that we will be able to make a cost-effective upgrade to the service at Brewster, since the Local Exchange Carrier cannot provide the circuits into the site. Upgrade of the service to a fractional T1 (at 384 kbps) at the St. Croix antenna is scheduled to be completed by AT&T next quarter.

The network of video teleconferencing units continues to be a fundamental resource for inter-site meetings. A new video unit was purchased to support videoconferencing in the recently occupied AOC West facility in New Mexico. However, because the meeting room is not yet ready, the new unit is still not deployed. Major upgrades to the capabilities are possible in the next year, but these will not be planned in detail until it is clear how much effort will be available. We will also continue to investigate the deployment of equipment and software for use by individuals in their offices.

The Ethernet switches in Green Bank are becoming outdated and have reached their limit for expansion. Furthermore, we no longer have staff members who are conversant with the operating system on those switches. We have therefore begun funding a program to replace them with new Cisco switches, which will be more capable and more expandable. The initial new switch will provide more capability for the GBT operation. We have also agreed to fund the completion of the communication infrastructure in the Green Bank Residence Hall to provide modern network capabilities in all visitor accommodation.

Education and Public Outreach

Education and Public Outreach (EPO) Highlights

During this quarter, the EPO staff initiated two new programs in response to recommendations made by the NRAO/AUI Visiting Committee: the Legacy Imagery Project and the Science Museum Outreach. The Legacy Imagery Project will develop in-house capability to process astronomical data acquired at radio wavelengths into visually compelling imagery. The new Science Museum Outreach efforts will bring the NRAO science and outreach to major museums in the United States. The EPO staff is working with their colleagues at the Space Telescope Science Institute (STScI), crafting mutually beneficial collaboration between the NRAO and the STScI to enable these programs. The staff also wrote and distributed several press releases about recent radio astronomy scientific research results. Attendance and revenue at the Green Bank Science Center and VLA Visitors Center continued to increase, marking substantial improvements over the same quarter last year. Progress continued on plans for a new visitor's center at the VLA. An exciting, large regional star party sponsored by the Central Appalachian Astronomy Club was hosted in Green Bank, drawing amateur astronomers from across the Midwest and the East. In Socorro, the inaugural *Radio Astronomy for Teachers* course was offered through New Mexico Tech's Master of Science Teaching program. This two-week radio astronomy class for teachers was a direct outgrowth of the NRAO teacher workshop, *"Doing Dishes"* funded by a NASA IDEAS grant. During this quarter, more than 30 NRAO employees participated in more than 60 EPO activities.

Legacy Imagery Project

The Legacy Imagery Project is an NRAO initiative to improve and upgrade the Observatory's capability to process radio-wavelength astronomical data into compelling visual imagery for use in education and public outreach (EPO) programs. Since the Space Telescope Science Institute's Hubble Heritage Program is the "gold standard" for EPO astronomical imagery, the NRAO staff arranged two meetings with STScI EPO staff this quarter (July and September). In these meetings, the NRAO staff reviewed and discussed the resource requirements and production timelines for Hubble Heritage Program astronomical imagery production. These discussions included the personnel (FTEs) requirements of the Hubble Heritage Program, as well as the program's computer hardware, software, processing techniques, and production timelines. Potential, mutually beneficial NRAO – STScI collaborations were also explored, e.g., a project to plan, acquire, process, and distribute a high quality, joint radio – optical image.

Education and Public Outreach

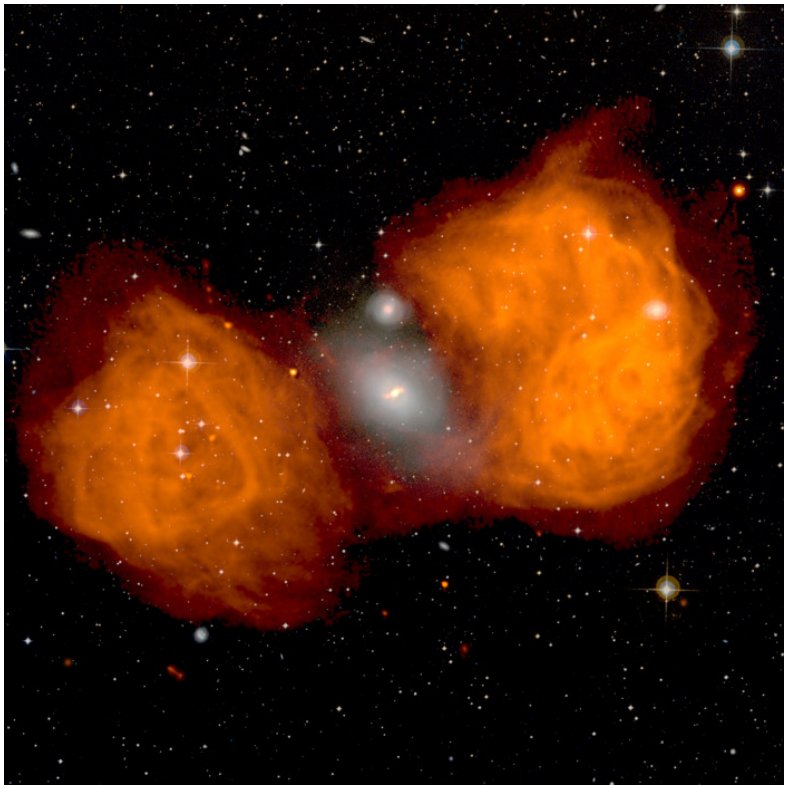

Figure 1. Fornax A (NGC 1316) VLA image of radio emission superimposed on optical field (STScI/POSS-II) (Investigators: E. Fomalont, R. Ekers, K. Ebneter, W. van Breugel)

NRAO scientist Juan Uson assisted EPO staff this quarter with the kickoff of the Legacy Imagery Project by researching and exploring a range of radio data visualization techniques and applying these techniques to existing radio images. Uson has generated several new radio images from archival data, including the Fornax A image in Figure 1, a re-visualization of radio data acquired by Fomalont, et al with the VLA, displayed here as a composite with STScI / POSS II optical data of the galaxy NGC 1316 and its surrounding field. This composite radio—optical image will appear in the 2005 American Astronomical Society (AAS) calendar. Additional images produced in this effort will be printed as posters and distributed at the January 2005 AAS Meeting in San Diego. The Observatory will also announce a radio image production contest at the January AAS meeting, seeking to motivate astronomers, especially graduate students, to generate high quality radio images that can be used to publicize astronomical research conducted at the NRAO and to generate additional high quality images for the NRAO on-line Image Gallery.

Education and Public Outreach

Science Museum Outreach

In addition to the Legacy Imagery Project, the NRAO EPO staff has initiated another new program this quarter: the Science Museum Outreach program. This program will deliver NRAO science education outreach to museums and planetariums across the United States. To accomplish this goal as efficiently as possible, the NRAO EPO staff began this quarter by seeking a mutually beneficial collaboration with the STScI personnel who operate and maintain the *ViewSpace* exhibits. *ViewSpace* is a free, continually updated, multimedia exhibit designed for museums and planetariums. *ViewSpace* brings well-crafted educational presentations about astronomy, astronomical research, and the Hubble Space Telescope into numerous facilities and is currently installed at fifty museums and planetariums across the United States. *ViewSpace* uses a Windows PC, simple speakers, and a large-format display—data-grade video projector, plasma display panel, or presentation monitor—to show free-running multimedia presentations. *ViewSpace* presentations combine imagery, digital movies, animations, interpretive captions, and music to effectively and attractively discuss modern astronomical research.

ViewSpace programming can be customized, site-by-site, and is modular. The EPO staff is working to design, produce, and deliver three program modules to the 50+ *ViewSpace* museums and planetariums in FY2005. The first delivered NRAO *ViewSpace* program module will be a software template for press release text and imagery that can quickly upload and display NRAO press releases at the subscribing museums and planetariums. This NRAO press release *ViewSpace* module will go operational in CY2005 Q1. A second, more sophisticated and lengthier *ViewSpace* module that provides an overview of radio astronomy and the NRAO will be designed and produced early in CY2005, with delivery to the *ViewSpace* subscriber sites by CY2005 Q2. An ALMA program module will be designed in early CY2005 and will be delivered to the *ViewSpace* sites by summer 2005.

Media Relations

As always, the NRAO EPO staff collaborated with Observatory scientists and members of the external astronomical community to produce and distribute press releases this quarter on recent and exciting science derived from the NRAO telescopes and data. These included the GBT discovery of a reservoir of simple sugar molecules at the Galactic Center (a feature article in the *Washington Post*), a microquasar shot out of a star cluster as a binary pair, confirmation of the existence of a new class of gamma-ray bursts, an investigation of galaxy cluster building, and significant new research on a pulsar system originally discovered with the VLA.

A video crew funded by the European Southern Observatory (ESO) visited the VLA, the Array Operations Center in Socorro, the ALMA Test Facility at the VLA, and the NRAO Technology Center in Charlottesville to shoot footage for future ALMA productions. A second film crew shot footage at the VLA for a television series that will be hosted by Sir Martin Rees, the Astronomer Royal.

Education and Public Outreach

B-roll footage (general views) on the NRAO observing sites were sent by request for use on the History Channel's "Tactical to Practical" program and to Michigan Technological University for use at the Michigan Youth, Engineering and Science Expo on November 6, 2004 in Ann Arbor.

The EPO staff also collaborated with NRAO North American ALMA Science Center (NAASC) personnel on a display for an AAS-sponsored symposium in Washington, D.C.: "Chile and the United States: Partners in Astronomy." This display will also be transported to the January 2005 AAS Meeting in San Diego and used in concept with the ALMA Town Meeting.

The recently completed ALMA DVD was translated into an NTSC-version for distribution in the United States and Canada.

Promotional contacts and media arrangements were made in Charlottesville in preparation for the November 2004 Jansky Lecture.

Informal Education

ttendance at the Green Bank Science Center and at the VLA Visitor Center continued their recent upward trends, as shown below. This quarter is typically the strongest of the year for both centers. Attendance was up by 10 percent and 29 percent, respectively, at Green Bank and the VLA compared to these same months in 2003.

Site	June	July	Aug	Quarterly Total
Green Bank	7,274	6,001	3,269	16,544
VLA	3,544	2,062	1,667	7,273

Attendance at the Green Bank Science Center was robust, with more than 16,500 visitors in three months. Over the previous year, attendance was lowest in December (375) and highest in July (7,274). In its first full year of operation, the Green Bank Science Center was visited by school groups (10 percent) other children/students (20 percent), senior citizens (17 percent), and individual adults (53 percent). Two new exhibits, describing blackbody and infrared radiation, were installed at the Green Bank Science Center this quarter.

Education and Public Outreach

Figure 2. Green Bank Science Center looking towards the GBT.

The VLA recorded a quarterly attendance increase of 8,000+ persons (53 percent). Over the previous year, the lowest monthly attendance occurred in December (1,062), and the highest monthly attended was recorded in July (3,544).

Revenue at the Green Bank Science Center and the VLA Visitor Center, as illustrated by the table below, has been impressive and has exceeded projections, particularly in New Mexico. In particular, visitors are spending more money per person than originally estimated.

Gift Shop	Fiscal Year	Predicted	Actual
Green Bank	2003	$ 80,000	$ 85,990
"	2004	$120,000	$149,349
VLA	2003	$ 23,500	$ 47,281
"	2004	$ 65,000	$134,628

The Café at the Green Bank Science Center is increasingly popular, though it has not quite achieved its revenue projections. The Café's financial performance is shown in the table below.

Fiscal Year	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total	Original Projection
2002-2003	0	0	$4,134	$14,907	$19,041	$72,000
2003-2004	$10,518	$6,793	$15,955	$23,909	$57,175	$108,000

Education and Public Outreach

Figure 3. The Starlight Café at the Green Bank Science Center.

Progress continued this quarter on developing plans for a new visitor's center at the VLA. One year ago, the gift shop construction revealed that, in addition to the current 2,400 square foot center's inability to accommodate existing visitation, the original building structure is deteriorating. The roof has been replaced twice, and the restroom facilities are inadequate for larger classes. Plans for a new visitor center of 15,000 square feet with 5,000 square feet of exhibit are being developed. In summer 2004, the University of New Mexico School of Architecture and Planning was commissioned to work on design concepts for a new center, while a VLA committee worked on developing a business plan.

The Central Appalachian Astronomy Club held a large star party, *Star Quest*, at Green Bank this summer, with 150 registered adults. The camping area was strewn with red-cellophaned windows, and several vendors set up displays in the lower level of the Science Center. There were no significant RFI issues. Fifty people used the NRAO 40-foot telescope. Though night-time observing conditions were only fair, the group plans to repeat the event next year.

Figure 4. Setting up telescopes at Star Quest.

Formal Education

Summer is the busiest time for the Observatory's formal education programs. This summer, Green Back hosted an NRAO/NASA *Living with a Star* workshop for 15 teachers. In addition to instructors from NASA, the University of Virginia, and the University of Maryland, several NRAO employees served as mentors, lecturers, and tour guides. This program was followed by NRAO's *RARECATS* teacher workshop that hosted 20+ participants for two weeks. *RARECATS* includes opportunities to conduct research with the Observatory's 40-foot radio telescope, an astronomy mini-course with field-tested activities for the classroom, cutting-edge research discussion with NRAO and visiting scientists, and collaboration with science educators to create student research projects.

The teacher programs at Green Bank were followed by a three-day session for 9th grade students in GEAR-UP camp, a federal program to help high school students get to and succeed in college. (see *http://gearup.k12.wv.us*) These students observed with the 40-foot telescope, worked on an engineering project, and participated in a simulated Mars mission.

Three teachers were in Green Bank this summer for extended professional development programs offered by the Observatory, two as RET teachers and one participating in a NASA IDEAS grant program called *Quiet Skies*. The intent of *Quiet Skies* is to develop a simple RFI detector that can be used by school groups in an inquiry-based mode to learn about radio frequency interference, measure radio

frequency interference in their locale, and report the results to the NRAO. This summer, instrumentation and curriculum were developed. Next summer teachers will be trained to use both the instruments and the curriculum and take them back to their classrooms. Both RET teachers will present their research at the San Diego AAS meeting in January 2005.

Figure 5. RET teacher Charles Gear checks for power line noise.

In Socorro, the Chautauqua program, *Interferometry in Radio Astronomy*, was held in July, and the inaugural *Radio Astronomy for Teachers* course was jointly offered in July by the NRAO and New Mexico Tech. Radio Astronomy for Teachers is a two-week class for teachers in New Mexico Tech's Master of Science Teaching program. Curricula for this course were developed via the NASA IDEAS grant program, *Doing Dishes*, held earlier this summer at NRAO - Socorro.

Students from the Oil City, Pennsylvania area and Marshall University in West Virginia were also observers with the 40-foot telescope this summer. The week-long *Education Research in Radio Astronomy* (ERIRA) workshop is a cooperative effort of the NRAO, the University of Chicago, and Ohio State University. This workshop provided tours and observing projects for high school and undergraduate students. The National Youth Science Camp again toured the Observatory, challenging our staff and facilities to simultaneously accommodate 120 visitors.

Figure 6. Itty Bitty Radio Telescope constructed by teacher in the Radio Astronomy for Teachers course. (See http://www.aoc.nrao.edu/epo/teachers/ittybitty/procedure.html)

Community Relations

Green Bank hosted two dozen junior girl scouts for a badge-earning day this quarter. Troop leaders and the scouts had such a good experience that the West Virginia Girl Scout Council is planning a return visit to the Observatory in spring 2005. Star Parties continue to be held monthly at Green Bank from June through October.

Private guided VLA tours were provided for the Summer Science Program at New Mexico Tech, and for the Shuttle Camp run by the New Mexico Museum of Space History. In Charlottesville, arrangements have been made for collaborative observing session with the local astronomy club for the October 2004 total lunar eclipse.

During this quarter, 30 NRAO employees volunteered time to participate in more than 60 EPO community-related activities. These activities included replying to on-line astronomy questions, special tours and presentations at Green Bank, VLA tours, star parties, planetarium presentations, mentoring persons participating in the Research Experiences for Undergraduate and Research Experiences for Teachers programs, radio interviews, newspaper interviews, ham radio presentations, and Chautauqua presentations. Staff also assisted EPO efforts with support for exhibit hardware, exhibit software, teacher classes / workshops, and web content.

Environment, Safety, and Security

Environment, Safety, and Security (ES&S) Highlights

Environment, Safety, and Security (ES&S) continued to make periodic security checks and look for potential problems. ES&S participated in several reviews for the ALMA project including one on fire protection for the correlator to be installed at the Array Operations Site in Chile. During this quarter, extensive work was performed on the NRAO-wide laser safety program to provide guidance for the safe use of both fiber and free-space lasers. The final safety-program requirements for the use of the Jackson 7000 rail tamper at the VLA were met this quarter. At Green Bank, the annual sprinkler inspection was conducted to test the site life/fire safety measures. At Green Bank and Charlottesville, training programs for the use of Automated External Defibrillators (AED) were initiated.

ALMA

Although construction activities at the ALMA Antenna Test Facility (ATF) site have slowed considerably, ES&S continued to provide periodic support services to check on security and look for potential problems. This effort included support for issues such as trouble-shooting the Vertex antenna Minerga cooling system and the drive system on the AEC antenna.

ES&S participated in several reviews for the ALMA project. These included reviews of fire protection for the correlator to be installed at the Array Operations Site in Chile, antenna transporter requirements, and the hazard analysis performed by the Back End team.

NRAO-New Mexico

Members of the NRAO ES&S Division continued to provide support for the local community by assisting the Socorro County Local Emergency Planning Committee to develop an all-hazards disaster plan for Socorro County.

ES&S invested considerable resources in the NRAO-wide laser safety program. The program provides safety guidance for the use of both fiber and free-space lasers. The effort was concentrated in Socorro to meet the needs of both the ALMA and EVLA construction projects.

The final safety-program requirements for the use of the Jackson 7000 rail tamper were met this quarter. A contractor was hired and provided comprehensive training for the operation and maintenance of this rail tamper. The effort included procedures for both maintenance and safe operation.

ES&S members participated in professional development programs covering rotor-wing landing-zone training for emergency response activities plus OSHA compliance and workplace safety.

Environment, Safety, and Security

Considerable effort was expended on the development of specifications for a fire-protection system to be installed in the new screen room which will contain the new EVLA WIDAR Correlator.

NRAO-Green Bank

During this quarter, ES&S participated in the annual Business Managers Meeting held in Tucson. Specific issues addressed included policy positions on the Vehicle Safety Policy, employee medical exams, and waivers of release for use of NRAO facilities.

At the Green Bank site, the annual sprinkler inspection was conducted to ensure that the life/fire safety measures for the site are properly functioning. No significant issues were noted during the inspection.

This period witnessed the installation of Automated External Defibrillators (AED) and training programs for their use on the site. AEDs were installed in the Jansky Lab and in the Residence Hall. The AEDs are for use by authorized and trained personnel to assist in the event of an employee or visitor heart attack.

ES&S attended a West Virginia Workers Compensation seminar to develop an understanding of local workers-compensation requirements for reporting and reducing accidents as well as to learn about insurance premiums.

The GBT operations and maintenance staff replaced the grease in the bearings of the GBT. ES&S provided for the proper identification of these waste materials to both reduce the cost associated with disposal of uncharacterized waste and to ensure appropriate waste-stream processing. ES&S assisted in the proper disposal of the contaminated waste grease and debris from the GBT in accordance with EPA requirements.

NRAO-Charlottesville

In Charlottesville, the NTC building was inspected for ventilation requirements in the machine shop. The need for additional ventilation was reviewed for exhaust hoods used in welding/soldering activities. In Charlottesville, as in Green Bank, two AEDs were placed into service and CPR / AED training was provided to ten employees at the NTC. Education and awareness efforts are provided to employees to assure that employees are adequately trained and educated on ES&S issues. NRAO will continue to limit the severity and frequency of occupational injures and illnesses by emphasizing safety education and safe work practices for all employees.

Future Efforts

During the next quarter ES&S will initiate a safety-management program for crane and hoist operations and will supervise the proper disposal of waste chemicals from the NTC chemistry lab.

The ES&S Division will lose a valued member to retirement in the next quarter. It is anticipated that a suitable replacement will be recruited and begin working on the ES&S efforts. Failure to provide a timely replacement would delay the goals of the ES&S Division. The current staffing level of ES&S is as follows:

Location	Position	FTEs
Green Bank	ES&S Manager	1
Green Bank	Administrative Support	½
Socorro, VLA	Safety Officer	1 ¾
Tucson	Deputy Safety Officer	0
Charlottesville	Deputy Safety Officer	0
ALMA Project, VLA Site	Safety Officer	¼
NRAO ES&S Total		3 ½

Telescope Usage

The NRAO telescopes were scheduled for research and maintenance during the third quarter of 2004 as described in the table below. Note that time lost and actual observing for the arrays are computed as fractions of the total antenna arrays. For example, losing 27 VLA antennas for one hour counts as 1.0 hour of time lost, while losing one out of ten VLBA antennas for one hour counts as 0.1 hours of time lost. Also note that in the case of the GBT, Test and Calibrations occasionally require less time than is scheduled for them, and the excess time is then allocated to refereed backup science programs.

Activity	**VLA** (hrs)	**VLBA** (hrs)	**GBT** (hrs)
Scheduled Observing	1695.38	1108.7	1164.0
Scheduled Maintenance and Equipment Changes	374.33	258.8	613.0
Scheduled Tests and Calibration	247.53	312.0	431.0
Time Lost	130.18	30.9	92.0
Actual Observing	1565.20	1077.8	1072.0

GBT Observing Programs

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

No.	Observer(s)	Programs
BT075	Tarchi, A. (Osservatorio Astro di Calgari) Brunthaler, A. (MPIR, Bonn) Henkel, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Moscadelli, L. (Stazione Astro. di Caglia) Chiaberge, M. (IRA - Bologna)	3C403: Is the water maser in an FRII associated with an accretion disk or is it due to a jet interaction? 1.3 cm
GBT01A-004	Turner, B. Brown, R. (NAIC) Dennison, B. (Va. Polytechnic Inst.) Minter, A.	A search for the fine structure of the hydrogen atom. 3.5 cm
GBT01A-029	Eales, S. (Cardiff) Carilli, C. Dunne, L. (Cardiff) Ivison, R. (Astro. Tech. Centre)	A first investigation of the origin of galaxies with the GBT. 1.3 cm
GBT01A-078	Stairs, I. (British Columbia) Kaspi, V. (McGill)	A 20 cm search for pulsars in globular clusters. 21 cm
GBT02A-003	Darling, J. (Carnegie Institution) Giovanelli, R. (Cornell)	Do hyperluminous IR galaxies produce OH gigamasers?
GBT02A-021	Lockman, F. J. Roshi, A. (Raman Research Inst.) Balser, D.	A search for recombination lines from diffuse gas in the Galactic Center region. 6, 11, 21 cm
GBT02A-028	Braatz, J. Langston, G. McMullin, J. Garwood, R.	Exploring the radio spectrum of Orion A and W51. 1.3 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT02A-044	Barvainis, R. (NSF) Antonucci, R. (UCSB)	A search for CO from the epoch of reionization. 2 cm
GBT02A-046	Braatz, J. Henkel, C. (MPIR, Bonn) Wilson, A. (Maryland)	Monitoring a maser disk in Mrk 1419. 1.3 cm
GBT02A-069	Fisher, R.	Galaxy survey of HI emission. 21 cm
GBT02C-002	Carilli, C. Stocke, J. (Colorado) Menten, K. (MPIR, Bonn) Langston, G. Rector, T. Dwarakanath, K.	Redshifted HI absorption towards red gravitational lenses (J0134-0931, J1004+1229). 21cm
GBT03B-013	Yun, M. (Massachusetts) Schneider, S. (Massachusetts) Brinks, E. (INAOE) Bravo-Alfaro, H. (Universidad de Guanajuato, Mexico)	An unbiased HI survey of the Coma Cluster and beyond. 21 cm
GBT03B-015	Ransom, S. Stairs, I. (British Columbia) Kaspi, V. (McGill) Hessels, J. (McGill) Backer, D. (UC, Berkeley)	Timing the pulsars in the globular cluster M30. 11, 21 cm
GBT03B-042	Dyer, K.	Continuum reobservations of galactic SNRs. 6 cm
GBT03C-001	Coster, A. (MIT Lincoln Laboratory) Phelps, E. (MIT Lincoln Laboratory)	Ionospheric effects on coherence time scales. 3.5, 21, 70 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT03C-009	Darling, J. (Carnegie Institution)	A direct measurement of fine structure "constant" evolution from OH and HI absorption lines.
GBT03C-031	Jacoby, B. (Caltech) Anderson, S. (Caltech) Kulkarni, S. (Caltech) Kaplan, D. (Caltech) Backer, D. (UC, Berkeley)	Timing the pulsars in M62, NGC 6544, and NGC 6624 and search for ultra-fast pulsars. 21, 38 cm
GBT04A-003	Curran, S. (New South Wales) Whiting, M. (New South Wales) Webb, J. (New South Wales) Murphy, M. (New South Wales) Pihlstroem, Y. Wiklind, T. (Space Telescope Science Institute) Francis, P. (Australian National)	Highly-redshifted HI and OH absorption in red quasars. 38 cm
GBT04A-017	Crosthwaite, L. (Astute Networks) Turner, J. (UC, Los Angeles) Meier, D. (Illinois, Urbana-Champaign) Tsai, C. (UC, Los Angeles)	A search for HI tidal interaction debris in the vicinity of NGC 5253. 21 cm
GBT04A-029	Ransom, S. Camilo, F. (Columbia) Stairs, I. (British Columbia) Kaspi, V. (McGill) Kaplan, D. (Caltech)	S-Band pulsar observations of Terzan5 and Liller1. 11 cm
GBT04A-030	Stairs, I. (British Columbia) Thorsett, S. (UC, Santa Cruz) Arzoumanian, Z. (NASA/GSFC) Ferdman, R. (British Columbia)	High-precision timing of binary pulsars at the GBT. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04A-035	Stairs, I. (British Columbia) Faulkner, A. (NRAL) Kramer, M. (NRAL) Lyne, A. (NRAL) Manchester, D. (Australia Telescope) Hobbs, G. (ATNF) Possenti, A. (Osservatorio di Cagliari) Lorimer, D. (Manchester) Kaplan, D. (Caltech) Camilo, F. (Columbia)	Scintillation velocities for two relativistic binary pulsars. 11, 21 cm
GBT04A-045	Roberts, M. (McGill) Hessels, J. (McGill) Ransom, S. Kaspi, V. (McGill) Tam, C. (McGill) Livingstone, M. (McGill) Backer, D. (UC, Berkeley) Crawford, F. (Haverford College) Kaplan, D. (Caltech)	Timing of three binary pulsars discovered in a survey of mid-latitude EGRET error boxes. 21, 38 cm
GBT04A-046	Akos, D. (Stanford) Harrison, N. (Stanford)	Global Positioning System satellite anomaly investigation using the Robert C. Byrd Green Bank Telescope. 21 cm
GBT04A-047	Ransom, S. Kaspi, V. (McGill) Kaplan, D. (Caltech) Roberts, M. (McGill)	A search for radio pulsars around the massive black hole at the Center of the Galaxy. 6 cm
GBT04B-001	Goldsmith, P. (Cornell) Li, D. (CfA) Tang, Y. (Cornell)	GBT observations of narrow HI absorption as a probe of molecular cloud evolution. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04B-003	Singhal, A. (Virginia) Fisher, R. O'Neil, K. Murphy, E. (Virginia)	The connection between galaxy kinematics and HI line widths as applied to the distance scale. 21 cm
GBT04B-004	Ma, C. (National Taiwan) Lim, J. (SA/IAA, Taiwan)	Search for HI gas in the central molecular-gas-rich elliptical galaxies of rich clusters. 21 cm
GBT04B-005	Robishaw, T. (UC, Berkeley) Heiles, C. (UC, Berkeley)	Probing the magnetic field in M31 with the Zeeman effect. 21 cm
GBT04B-007	Law, C. (Northwestern) Yusef-Zadeh, F. (Northwestern) Maddalena, R. Cotton, W. Roberts, D.A. (Northwestern)	A study of the Galactic Center lobe. 6 cm
GBT04B-008	Knight, (Swinburne) Bailes, M. (Swinburne) Ord, S. (Swinburne) Jacoby, B. (Caltech) Kulkarni, S. (Caltech) Camilo, F. (Columbia) Hotan, H. (Swinburne)	A high sensitivity millisecond pulsar survey. 38 cm
GBT04B-009	Lazio, T. J. W. (NRL) Cordes, J. (NAIC and Cornell)	Direct detection of baryons in the Local Group: giant pulses from extragalactic pulsars. 90 cm
GBT04B-010	Campbell, B. (CfA) Campbell, D. (Cornell)	Bistatic radar observations of the lunar highlands. 70 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04B-011	Rickett, B. (UC, San Diego) McLaughlin, M. (Manchester) Coles, W. (UC, San Diego) Lyne, A. (NRAL) Stairs, I. (British Columbia) Camilo, F. (Columbia) Freire, P. (Arecibo Observatory)	Scintillation studies of the J0737-3039 binary system. 6, 11 cm
GBT04B-017	Lovell, A. (Agnes Scott College) Schloerb, F. (Massachusetts) Howell, E. (Arecibo Observatory)	OH observations of long-period comets. 21 cm
GBT04B-018	Jacoby, B. (Caltech) Bailes, M. (Swinburne) Ord, S. (Swinburne) Kulkarni, S. (Caltech) Hotan, H. (Swinburne) van Straten, W. (Astron)	Precision pulsar timing. 21 cm
GBT04B-020	Humphreys, L. (CfA) Reid, M. (CfA) Greenhill, L. (CfA) Wilner, D. (CfA) Kondratko, P. (CfA)	Search for water megamasers through gravitational lenses. 2.5, 6 cm
GBT04B-021	Troland, T. (Kentucky) Brogan, C. (JCMT) Crutcher, R. (Illinois)	The 13 GHz SO Zeeman effect in an outflow region. 2 cm
GBT04B-022	Troland, T. (Kentucky) Benjamin, R. (Wisconsin-Whitewater) Lockman, F. J.	The magnetic field in a compact high velocity cloud. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04B-024	Yun, M. (Massachusetts) Kim, S. (Massachusetts) Heyer, M. (Massachusetts) Lowenthal, J. (Smith College)	HI survey of the Spitzer First Look Survey galaxies. 21 cm
GBT04B-026	Kramer, M. (NRAL) Stairs, I. (British Columbia) Camilo, F. (Columbia) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Lyne, A. (NRAL) Manchester, D. (Australia Telescope) Possenti, A. (Osservatorio di Cagliari) D'Amico, N. (Osservatorio di Cagliari) Burgay, M. (Osservatorio di Bologna) Freire, P. (Arecibo Observatory) Joshi, B. (National Centre for Radio Astrophysics (India)) Ferdman, R. (British Columbia)	Timing the first double pulsar system. 21, 38 cm
GBT04B-028	Ransom, S. Kaspi, V. (McGill) Backer, D. (UC, Berkeley) Ramachandran, R. (UC, Berkeley) Demorest, P. (UC, Berkeley) Arons, J. (UC, Berkeley)	Multi-epoch multi-frequency scintillation velocity measurements of the double-pulsar binary J0737-3039. 21, 38 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04B-029	Stairs, I. (British Columbia) Camilo, F. (Columbia) Kramer, M. (NRAL) Faulkner, A. (Nuffield Radio Astronomy Laboratories) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Lyne, A. (NRAL) Hobbs, G. (ATNF) Manchester, D. (Australia Telescope) Possenti, A. (Osservatorio di Cagliari) D'Amico, N. (Osservatorio di Cagliari) Burgay, M. (Osservatorio di Bologna) Ferdman, R. (British Columbia) Ramachandran, R. (UC, Berkeley) Backer, D. (UC, Berkeley) Demorest, P. (UC, Berkeley) Nice, D. (Princeton)	Timing new binary and millisecond pulsars from the Parkes Multibeam Survey. 21 cm
GBT04B-035	Camilo, F. (Columbia) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Stairs, I. (British Columbia) Possenti, A. (Osservatorio di Cagliari) Kramer, M. (NRAL) Manchester, D. (Australia Telescope) Joshi, B. (National Centre for Radio Astrophysics (India)) Freire, P. (Arecibo Observatory) Lyne, A. G. (NRAL) Burgay, M. (Osservatorio di Bologna) D'Amico, N. (Osservatorio di Cagliari)	Spectral and temporal studies of the two pulsars in the J0737-3039 system. 6, 11, 21, 90 cm
GBT04B-036	Demorest, P. (UC, Berkeley) Backer, D. C. (UC, Berkeley) Ferdman, R. (British Columbia) Stairs, I. (British Columbia) Nice, D. (Princeton) Ramachandran, R. (UC, Berkeley)	Precision timing of binary and millisecond pulsars. 21, 38 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04B-037	Ransom, S. Kaspi, V. (McGill) Roberts, M. (McGill)	A pilot 350 MHz survey for fast pulsars. 90 cm
GBT04B-039	Heyer, M. (Massachusetts)	Test observations of HI absorption in the galaxy. 21 cm
GBT04C-008	Pidopryhora, Y. (Ohio) Shields, J. (Ohio) Lockman, F. J.	Mapping the galactic halo HI: evidence of outflow from the galactic plane? 21 cm
GBT04C-012	Donovan, J. (Columbia) Camilo, F. (Columbia)	Deep searches for young pulsars in "shell" supernova remnants. 38 cm
GBT04C-018	Bolatto, A. (UC, Berkeley) Darling, J. (Carnegie Institution)	A search for cosmological HI absorption systems toward radio selected flat-spectrum sources.

VLA Observing Programs

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

No.	Observer(s)	Programs
AB1093	Blundell, K. (Oxford) Rawlings, S. (Oxford)	High-z FRI quasars. 20 cm
AB1124	Brosius, J. (NASA/GSFC) White, S. (Maryland) Kuhn, J.(Hawaii) Lin, H. (Hawaii)	Coordinated solar coronal magnetography. 2, 3.6, 6, 20 cm
AB1125	Batrla, W. (ESO) Wilson, T. (MPIR, Bonn) Menten, K. (MPIR, Bonn)	Ammonia towards the Orion bar PDR. 1.3 cm
AB1126	Bastian, T. Benz, A. (SFIT, ETH) Solanki, S. (MPI, Landau) Loukitcheva, M. (SPbS) White, S. (Maryland)	Solar chromosphere at mm and cm wavelengths. 0.7, 1.3, 2 cm
AB1127	Bower, G. (UC, Berkeley) Yusef-Zadeh, F. (Northwestern) Roberts, D. (Northwestern) Falcke, H. (MPIR, Bonn)	Coordinated XMM, VLT, Keck, and VLA observations of Sgr A*. 0.7, 1.3 cm
AB1142	Bietenholz, M. (York) Bartel, N. (York) Rupen, M.	Continuum from Type II SNe more than ten years old. 1.3 cm
AB1146	Brunthaler, A. (MPIR, Bonn) Falcke, H. (MPIR, Bonn) Reid, M. (CfA) Greenhill, L. (CfA) Henkel, C. (MPIR, Bonn)	Search for more water masers in M33. 1.3 cm

VLA Observing Programs

No.	Observer(s)	Programs
AB1151	Bartel, N. (York) Bietenholz, M. (York) Rupen, M.	Monitoring the SED of SN 1986J. 0.7, 1.3, 2, 3.5, 6, 20 cm.
AB1153	Brogan, C. (Hawaii) Chandler, C. Shirley, Y.	Water masers toward W33A. 1.3 cm
AC696	Clarke, T. (Virginia) Kempner, J. (Virginia)	Radio halos in clusters of galaxies. 20 cm
AC706	Clarke, T. (Virginia) Sarazin, C. (Virginia)	Polarimetric and spectral-index study of cluster Abell 520. 20 cm
AC712	Croston, J. (Bristol, UK) Hardcastle, M. (Bristol, UK) Birkinshaw, M. (Bristol, UK) Worrall, D. (Bristol, UK)	Structure of FR-I radio galaxy NGC 1044. 20 cm
AC717	Chyzy, K. (Jagellonian) Bomans, D. (Ruhr) Beck, R. (MPIR, Bonn)	Polarimetry of blue compact dwarf IC 10. 20 cm
AC723	Chung, A. (Columbia) Bureau, M. (Columbia) vanGorkom, J. (Columbia) Koribalski, B. (CSIRO)	HI kinematics of spirals with counter-rotating ionized gas. 20 cm
AC729	Cool, R. (U. Arizona) Dale, D. (U. Wyoming) Bloom, S. (NASA/GSFC)	Spectral energy distributions of possible gamma-ray blazars. 1.3, 2, 3.6, 6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AC730	Clemens, M. (Cambridge) Bressan, A. (Padova) Prouton, O. (Padova) Granato, G. (Padova) Silva, L. (Trieste Observatory) Vega, O. (INAOE)	Spectral energy distributions for compact ULIRGs. 1.3 cm
AC736	Chung, A. (Columbia) van Gorkom, J. (Columbia) Bureau, M. (Columbia) Koribalski, B. (CSIRO)	Kinematic study of spirals with counter-rotating gas. 20 cm
AC742	Clarke, T. (Virginia) Sarazin, C. (Virginia) Blanton, E. (Virginia)	Structure of the cores of Abell 2597 and Abell 4059. 6, 20, 90 cm
AC752	Castangia, P. (Cagliari) Tarchi, A. (MPIR, Bonn) Henkel, C. (MPIR, Bonn) Peck, A. (CfA) Menten, K. (MPIR, Bonn) Nagar, N. (Arcetri) Moscadelli, L. (Bologna)	Water megamasers in the merger system Arp 299. 1.3 cm
AC761	Chatterjee, S. (Cornell) Brisken, W. Goss, W. M. Benson, J. Arzoumanian, Z. (NASA/GSFC) Lazio, T. J. W. (NRL) Cordes, J. (Cornell) Vlemmings, W. (Leiden) Thorsett, S. (UC, Santa Cruz) Lyne, A. (Manchester) Kramer, M. (Manchester)	Calibrator search for pulsar astrometry with the VLBA or HSA. 3.6, 20 cm
AD500	DeLaney, T. (Minnesota) Rudnick, L. (Minnesota)	Spectral-index imaging of Cassiopeia A. 6, 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AD502	Dougherty, S. (DRA) Pittard, J. (Leeds) Williams, P. (IfA, Edinburgh)	WR146—the wind collision spectrum and the O-star companion. 0.7, 1.3 cm.
AF414	Frail, D. Soderberg, A. (Caltech) Kulkarni, S. (Caltech)	Continued monitoring of the bright GRB 030329. 3.6, 6, 20 cm
AG639	Govoni, F. (Bologna) Markevitch, M. (CfA) Feretti, L. (Bologna) Giovannini, G. (Bologna)	Radio halos in merging and non-merging galaxy clusters. 20 cm
AG661	Govoni, F. (Bologna) Markevitch, M. ((CfA) Murgia, M. (Bologna) Feretti, L. (Bologna) Giovannini, G. (Bologna)	Deep polarimetry of relaxed and un-relaxed clusters of galaxies. 20 cm
AG663	Gudel, M. (SFIT, ETH) Montmerle, T. (CNRS, France) Audard, M. (Columbia) Walter, R. (INTEGRAL) Telleschi, A. (PSI)	Coordinated VLA-INTEGRAL study of the Algol system. 2, 3.6, 6 cm
AG664	Gomez, J-L. (IAA, Andalucia) deGregorio-Monsalvo, I. (IAA, Andalucia) Kuiper, T. (JPL) Torrelles, J. (IAA, Andalucia) Anglada, G. (IAA, Andalucia)	Thermal CCS and water masers in proto-binary system IRAS16293. 1.3 cm
AG665	Gomez, J-L. (IAA, Andalucia) deGregorio-Monsalvo, I. (IAA, Andalucia)	Ammonia towards the bipolar outflow in AFGL 437. 1.3 cm

VLA Observing Programs

No.	Observer(s)	Programs
AG669	Gawronski, M. (Copernicus/Torun) Marecki, A. (Copernicus/Torun) Kunert, M. (Copernicus/Torun) Kus, A. (Copernicus/Torun)	Hybrid-morphology sources. 20 cm
AG674	Gonzalez, D. (Imperial) Terlevich, R. (RGO) Terlevich, E. (INAOE) Schmitt, H. (Virginia)	Spectral indices of HII galaxies. 3.6, 6 cm
AH843	Hunter, D. (Lowell Observatory)	HI imaging of outer parts of dwarf irregulars. 20 cm
AH844	Heesen, V. (Bochum) Krause, M. ((CfA)) Beck, R. (MPIR, Bonn) Dettmar, R. (Bochum) Ehle, M. (ESA, Spain)	Spectral indices and polarimetry of starburst NGC253. 6 cm
AH847	Humphreys, E. (Chalmers, Onsala) Reid, M. (CfA) Greenhill, L. (CfA) Moran, J. (CfA) Argon, A. (CfA)	Monitoring of water maser spectrum and jet continuum of NGC 4258. 1.3, 3.6 cm
AH848	Hieret, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Schilke, P. (MPIR, Bonn) Alcolea, J. (Yebes Observatory)	Search for the NaOH molecule toward Sgr B2. 1.3 cm
AH861	Healy, K. (Arizona State) Claussen, M. Hester, J. (Arizona State) Snider, K. (Arizona State) Desch, S. (Arizona State)	Survey for water masers from low-mass stars near HII regions. 1.3 cm

VLA Observing Programs

No.	Observer(s)	Programs
AI113	Imai, H. (NFRA) Diamond, P. (Manchester) Deguchi, S. (NAOJ) Nakashima, J. (NAOJ) Miyazaki, A. (Ibaraki)	SiO and continuum from AGB star W43A. 0.7 cm
AI114	Ivison, R. (Royal Observatory) deBreuck, C. (Leiden) Papadopoulos, P. (Leiden) Neri, R. (IRAM) Greve, T. (Edinburgh)	Molecular gas distribution in a gas-rich merger at z=3.8. 0.7, 1.3 cm
AJ311	Joncas, G. (Laval) Boulanger, F. (CITA) Falgarone, E. (Ecole Normale) Lockman, F. J. Miville-Deschenes, M. (Inst. Theoretical) Martin, P. (CFHT, Hawaii)	Structure and kinematics of a cirrus cloud in Ursa Major. 20 cm
AK575	Kulkarni, S. (Caltech) Senko, S. (Caltech) Frail, D. Harrison, F. (Caltech) Fox, D. (MIT) Soderberg, A. (Caltech)	Triggered observations of GRB afterglows. 0.7, 1.3, 2, 3.6, 6, 20 cm
AK580	Kuo, C. (SA/IAA, Taiwan) Tang, Y-W. (SA/IAA, Taiwan) Lim, J. (SA/IAA, Taiwan) Ho, P. (CfA)	HI imaging of Seyfert galaxies. 20 cm
AK581	Kothes, R. (DRAO) Landecker, T. (DRAO) Wolleben, M. (MPIR, Bonn)	Kinematic distances to seven SNR through HI absorption. 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AK588	Kong, A. (CfA) Rupen, M. Sjouwerman, L.	VLA obs. of an ultra luminous super soft X-ray source in outburst. 3.6, 6 cm
AK589	Kulkarni, S. (Caltech) Cameron, B. (Caltech) Frail, D.	Search for radio flares from SGR 1806-20 in outburst
AL597	Laing, R. (Oxford) Bridle, A. Parma, P. (Bologna)	Spectrum of 3C31 from 74 to 8400 MHz. 3.6, 6, 20 cm
AL622	Lockman, F. J. Pidopryhora, Y. (Ohio) Liszt, H. Rupen, M.	Physical properties of HI clouds in Galactic halo and disk. 20 cm
AL623	Lu, F. (Massachusetts) Lang, C. (Iowa) Wang, D. (Massachusetts)	Structure and spectrum of diffuse emission from SNR G54.1+0.3. 3.6, 6, 20 cm
AL624	Lang, C. (Iowa) Goss, W. M. Johnson, K. (Madison) Rodriguez, L. F. (Mexico/UNAM)	High-frequency observations of compact sources in the Galactic Center Quintuplet Cluster. 0.7, .3 cm
AL627	Landt, H. (STScI) Bignall, H. (JIVE) Padovani, P. (STScI) Perlman, E. (of Maryland)	A sample of faint BL Lacertae objects. 20 cm
AL634	Lister, M. (Purdue) Kochancyzk, M. (Purdue)	Deep imaging of the MOJAVE blazar sample. 20 cm
AM790	Matthews, L. (CfA) Bureau, M. (Columbia)	HI structure and kinematics of edge-on spiral UGC 10043. 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AM793	Monnier, J. (CfA) Danchi, W. (NASA/GSFC) Greenhill, L. (CfA) Tuthill, P. (Sydney) Danchi, W. (NASA/GSFC)	Continuum monitoring of colliding wind binary WR 112. 3.5 cm
AM794	Machalski, J. (Jagellonian) Jamrozy, M. (Bonn) Koziel, D. (Jagiellonian)	Mapping the radio lobes in giant radio galaxies. 6 cm
AM797	Menten, K. (MPIR, Bonn) Alcolea, J. (Yebes Observatory)	Imaging peculiar ammonia emission around red giant stars. 1.3 cm
AM798	Matthews, L. (CfA) Reid, M. (CfA)	Neutral hydrogen observations of AGB stars. 20 cm
AM799	Montero-Castano, M. (Madrid Observatory) Herrnstein, R. (CfA) Ho, P. (CfA)	HC3N imaging around Sgr A*. 0.7 cm
AM800	Miller, E. (Michigan) Bregman, J. (Michigan)	HI mass of high velocity clouds in nearby spiral galaxies. 20 cm
AM806	Morganti, R. (NFRA) Oosterloo, T. (NFRA) Emonts, B. (Groningen/Kapteyn) van Moorsel, G. Tadhunter, C. (Sheffield)	Very broad HI absorption in radio galaxies. 20 cm
AM813	Mason, P. (New Mexico State) Gray, C. (UTEP)	Monitoring the cataclysmic variable AR UMa. 3.6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AO184	Osten, R. Hawley, S. (Michigan State) Bastian, T. Reid, I. (STScI)	Continuum emission from nearby cool stars and brown dwarfs. 3.6 cm
AP468	Pellizzoni, A. (Milan Observatory) Mereghetti, S. (Milano Observatory) Bignami, G. (Pavia) Caraveo, P. (Milan Observatory) DeLuca, A. (Milano Observatory) Mignani, R. (ESO) Tur, A. (CESR)	Radio counterpart of the X-ray structure around Geminga pulsar. 3.6, 6 cm
AP471	Po-Jian, C. (SA/IAA, Taiwan) VanTrung, D (SA/IAA, Taiwan). Lim, J. (SA/IAA, Taiwan)	Ammonia imaging of proto-planetary Egg Nebula. 1.3 cm
AP473	Pedelty, J. (NASA/GSFC) Mundy, L. (Maryland)	Mapping the molecules in the low-mass protostar IRAS16293. 0.7 cm
AP475	Pillai, T. (MPIR, Bonn) Wyrowski, F. (MPIR, Bonn) Menten, K. (MPIR, Bonn)	Ammonia emission toward massive dense cores with masers. 1.3 cm
AP476	Palau, A. (Barcelona) Estalella, R. (Barcelona) Beltran, M. (CfA) Girart, J. (Barcelona)	Continuum emission from embedded cluster candidates. 1.3, 3.6 cm
AP480	Palmer, P. (Chicago) Goss, W. M.	Calibrator search toward W75. 3.6 cm
AR543	Ribo, M. (Barcelona) Mirabel, I. F. (CNRS, France)	Counterpart to large-scale X-ray jet in LMXB 4U1755-338. 6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AR544	Reid, M. (CfA)	Kinematics of H66alpha in cometary HII regions. 1.3 cm line
AR545	Rupen, M. Mioduszewski, A. Dhawan, V.	Monitoring of X-ray binaries etc. 0.7, 1.3, 2, 3.6, 6, 20 cm
AR546	Roshi, D. Jeyakumar, S. (NCRA, India) Goss, W. M.	Carbon recombination lines near UCHII region W48A. 0.7 cm
AR550	Rodriguez, L. (Mexico/UNAM) Loinard, L. (Mexico/UNAM) D'Alessio, P. (Mexico/UNAM)	Search for protoplanetary disks around isolated Class 0 protostars. 0.7 cm
AR553	Rodriguez, L. (Mexico/UNAM) Marti, J. (U. Jaen) Trejo, A. (Mexico/UNAM)	Monitoring the ultra-luminous X-ray source in M33. 3.6 cm
AS791	Sakelliou, I. (Birmingham) Giovannini, G. (Bologna) Feretti, L. (Bologna) Ponman, T. (Birmingham)	Imaging the candidate radio halo in Abell 399. 20 cm
AS796	Soderberg, A. (Caltech) Kulkarni, S. (Caltech) Frail, D. Chevalier, R. (Virginia)	Triggering on further type Ibc SNe. 1.3, 3.6, 6, 20 cm
AS798	Schinnerer, E. Boker, T. (ESA)	HI in late-type spiral galaxies. 20 cm
AS799	Seaquist, E. (Toronto) Muhle, S. (Bonn)	Formaldehyde in starburst galaxy M82. 2 cm

VLA Observing Programs

No.	Observer(s)	Programs
AS800	Sjouwerman, L. Messineo, M. (Leiden) Habing, H. (Leiden) Honma, M. (NAOJ) Imai, H. (NFRA)	Monitoring circumstellar SiO masers near Sgr A*. 0.7 cm
AS801	Schinnerer, E. Carilli, C. Scoville, N. (Caltech) Bertoldi, F. (MPIR, Bonn) Blain, A. (Caltech) Bondi, M. (Bologna) Ciliegi, P. (Bologna) Impey, C. (Arizona) Koekemoer, A. (Mt. Stromlo) LeFevre, O. (Marseille Observatory) Urry, C. M. (Yale) Vettolani, P. (CNR-Bologna)	COSMOS deep 1.4 GHz imaging survey. 20 cm
AS805	Shirley, Y. Evans, N. (Texas)	Search for continuum emission from L1014-SMM1, a mid-IR source. 3.6, 6 cm
AS806	Schmitt, H. (Virginia) Anderson, J. (NMIMT) Cid-Fernandes, R. (UFSC) Heckman, T. (STScI) Gonzales-Delgado, R. (IAA) Storchi-Bergmann, T. (UFRGS)	Continuum images of Palomar LLAGNs at 6cm and 3.5cm. 3.6, 6 cm
AS807	Sokoloski, J. (Southampton) Mioduszewski, A. Brocksopp, C. (MSSL) Rupen, M. Kaiser, C. (MPIfEP, Garching)	Monitoring of symbiotic binaries during outburst. 2, 6, 20 cm
AS808	Shirley, Y. Young, K. (Texas) Evans, N. (Texas)	Completing a formaldehyde survey of pre-protostellar cores. 6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AS814	Snellen, I. (Royal Observatory) Best, P. (Royal Observatory) Rigby, E. (Royal Observatory)	Structure of high-redshift FR I candidates. 20 cm
AS815	Sarma, A. (Illinois) Claussen, M.	Water masers near high-mass protostellar objects. 1.3 cm
AS821	Strasser, S. (Minnesota) Dickey, J. (Minnesota)	OH absorption of background sources in the Galactic Plane. 20 cm
AT297	Tang, Y-W. (SA/IAA, Taiwan) Kuo, C-Y. (SA/IAA, Taiwan) Ho, P. (CfA) Lim, J. (SA/IAA, Taiwan)	Imaging the extended HI envelope around the M51 group. 20 cm
AV272	VanTrung, D. (SA/IAA, Taiwan) Lim, J. (SA/IAA, Taiwan)	Cyanopolyynes in carbon-rich stellar envelopes. 0.7, 1.3 cm
AV273	VanTrung, D. (SA/IAA, Taiwan) Lim, J. (SA/IAA, Taiwan)	Cyanopolyynes in post-AGB circumstellar envelopes. 0.7, 1.3 cm
AV276	Verdes-Montenegro, L. (IAA, Andalucia) Espada, D. (IAA, Andalucia) Bosma, A. (Marseille Observatory) Leon, S. (Cologne) Yun, M. (Massachusetts) Athanassoula, E. (Marseille Observatory) Sulentic, J. (Alabama)	HI asymmetries in well isolated galaxies. 20 cm
AW605	Walter, F. Brinks, E. (Guanajuato) de Blok, E. (Cardiff) Thornley, M. (Bucknell) Kennicutt, R. (Arizona)	HI structures of nearby galaxies. 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AW624	Weiler, K. (NRL) Stockdale, C. (NRL) Sramek, R. VanDyk, S. (UCLA) Panagia, N. (STScI) Marcaide, J. (Valencia) Lewin, W. (MIT) Pooley, D. (MIT) Immler, S. (Massachusetts) Ryder, S. (AAO)	Triggered observations of type II SNe. 1.3, 2, 3.6 cm
AW633	Walter, F. Brinks, E. (Guanajuato) Skillman, E. (Minnesota)	Blind search for HI clouds in the M81 group. 20 cm
AW635	Walter, F. Carilli, C. Bertoldi, F. (MPIR, Bonn)	Search for HCN & HCO+ from QSO J1148+5251 at z=6.4. 0.7 cm
AW636	Wilcots, E. (Wisconsin) Freeland, E. (Wisconsin) Stilp, A. (Wisconsin)	HI content of groups of galaxies. 20 cm
AW641	Weiler, K. (NRL) Stockdale, C. (NRL) Sramek, R. VanDyk, S. (UCLA) Panagia, N. (STScI) Marcaide, J. (Valencia) Lewin, W. (MIT) Pooley, D. (MIT) Immler, S. (Massachusetts) Ryder, S. (AAO)	Triggered observations of type II SNe. 2, 6, 20 cm.

VLA Observing Programs

No.	Observer(s)	Programs
AW642	Weiler, K. (NRL) Stockdale, C. (NRL) Sramek, R. VanDyk, S. (UCLA) Panagia, N. (STScI) Marcaide, J. (Valencia) Lewin, W. (MIT) Pooley, D. (MIT) Immler, S. (Massachusetts)	Long-term monitoring of radio supernovae. 1.3, 2, 3.6, 6, 20, 90 cm
AW643	Wilcots, E. (Wisconsin) Walter, F.	Structure and kinematics of HI in starburst IC 10. 20 cm
AW645	Walter, F. Carilli, C. Henkel, C. (MPIR) Ott, J. (ATNF) Staveley-Smith, L. (ATNF) Weiss, A. (IRAM)	Confirm a tentative CO detection at z=10. 1.3 cm
AX009	Xu, Y. (Shanghai Observatory) Reid, M. (CfA) Menten, K. (MPIR, Bonn) Zheng, X. (Nanjing) Moscadelli, L. (Bologna)	Astrometric calibrators for massive star-forming regions. 2 cm
AZ151	Zhao, J. (CfA) Pegg, J. (CfA) Lou, Y. (Tsinghua Univ.) Hong, X. (Shanghai Observatory) An, T. (Shanghai Observatory)	Monitoring the flux density variations of Sgr A*. 0.7, 1.3, 2 cm

VLBA Observing Programs

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

No.	Observer(s)	Programs
BA068	Asaki, Y. (ISAS) Deguchi, S. Hachisuka, K. (Valencia) Honma, M. (NAOJ) Imai, H. (JIVE) Miyoshi, M. (NAOJ)	Measuring the transverse motion of a galactic star. 1.3, 2 cm
BA071	Agudo, I. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Bach, U. (MPIR, Bonn) Bremer, M. (IRAM) Graham, D.(MPIR, Bonn) Grewing, M. (IRAM) Krichbaum, T. (MPIR, Bonn) Terasranta, H. (Metsahovi) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	A moving helical jet? 0.7, 2 cm
BB164	Browne, I. (Manchester) Jackson, N. (Manchester) Myers, S. Wilkinson, P. (Manchester)	Extreme scattering as an explanation of the anomalous quad/double. 2 cm
BB172	Brunthaler, A. (MPIR, Bonn) Falcke, H. (MPIR, Bonn) Greenhill, L. (CfA) Henkel, C. (MPIR, Bonn) Reid, M. (CfA)	Proper motions in the Local Group. 1.3 cm
BB176	Boboltz, D. (USNO) Marvel, Kevin (AAS)	OH12.8-0.9: An overlooked water fountain? 20 cm
BB185	Boboltz, D. (USNO) Driebe, T. (MPIR, Bonn) Ohnaka, K. (MPIR, Bonn) Wittkowski, M. (MPIR, Bonn)	Coordinated VLBA/VLTI observations of two evolved stars. 0.7 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BB197	Brisken, W. Shirley, Y. Summer Students	Summer student observing. 20, 90 cm
BC120	Chatterjee, S. (Cornell) Backer, D. (UC, Berkeley) Benson, J. Brisken, W. Cordes, J. (Cornell) Ellis, R. (UC, Santa Cruz) Fomalont, E. Golden, A. (Ireland) Goss, W. M. Kramer, M. (Manchester) Lazio, T. J. W. (NRL) Lyne, A. (Manchester) McKinnon, M. Thorsett, S. (UC, Santa Cruz) Wong, D. (Cornell)	Pulsar astrometry with the VLBA. 20 cm
BC127	Cawthorne, T. (Lancashire) Gabuzda, D. (Cork) Jorstad, S. (Boston) Marscher, A. (Boston) Stirling, A. (Lancashire)	Precessing jet in BL lacertae? 0.4, 0.7, 1, 2 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BC135	Cotton, W. Bakker, E. (Leiden) Chagnon, G. (Obs. de Paris) Coude du Foresto, V. (Obs. de Paris) Diamond, P. J. (Manchester) Kononen, P. (Metsahovie) McAllister, H. (Georgia State) Mennesson, B. (JPL) Perrin, G. (DESPA) Ragland, S. (CfA) Ridgway, S. (NOAO) Traub, W. (CfA) van Langevelde, H. (JIVE) Vlemmings, W. (Leiden) Waters, R. (Amsterdam)	VLA observations of bright O-rich Mira stars. 0.7 cm
BC141	Claussen, M. Morris, M. (UCLA) Sahai, R. (JPL) Sanchez-Contreras, C. (OVRO)	Magnetic fields in bipolar pre-planetary nebulae. 20 cm
BC145	Cotton, W. Chagnon, G. (Obs. de Paris) Lopez, B. (Cote d'Azur) Niccolini, G. (Cote d'Azur) Perrin, G. (DESPA) Schuller, P. (MPIR) Waters, R. (Amsterdam)	VLBA observations of bright O-rich AGB stars. 0.7 cm.
BD087	Dhawan, V. Fomalont, E. Lestrade, J-F. (Obs. de Paris) Mioduszewski, A. Rupen, M.	Astrometry of X-ray binaries. 0.4, 13 cm
BD098	Deacon, R. (Sydney) Chapman, J. (CSIRO) Green, A. (Sydney)	Imaging OH masers in post-AGB stars. 18 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BD099	Dallacasa, D. (Bologna) Orienti, M. (Bologna) Tinti, S. (Brera Observatory) Stanghellini, C. (Bologna)	Spectral imaging of two classes of CSOs. 3.6, 6, 18 cm
BD101	Dougherty, S. (DRAO) Beasley, A. (Caltech) Pittard, J. (Leeds) Claussen, M. Bolingbroke, N. (NRC) Zauderer, A. (Agnes Scott College)	Observing wind-collision and orbital motion in WR140. 0.7, 1.3, 2, 3.6 cm
BE026	Brand, J. (Bologna) Engels, D. (Hamburger Sternwarte) Perez-Torres, M.A. (Bologna)	Search for bipolar outflows in young proto-planetary nebulae. 1.3 cm
BE035	Edwards, P. (ISAS) Chen, A. (Milan) Digel, S. (Stanford) Fomalont, E. Hartman, R. (NASA) Mattox, J. (Fayetteville State) Piner, G. (Whittier) Vercellone, S. (Milan)	Testing the Mattox et al hypothesis. 0.4, 13 cm
BF072	Fassnacht, C. (STScI) Fomalont, E. Gehrels, N. (NASA) Michelson, P. (Stanford) Myers, S. Pearson, T. (Caltech) Readhead, T. (Caltech) Sjouwerman, L. Taylor, G. Ulvestad, J. Walker, R.C. Wrobel, J.	VLBA imaging and polarimetry survey. 2, 6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BF079	Fish, V. (CfA) Reid, M. (CfA)	Proper motions of OH masers in massive star-forming regions. 20 cm
BG114	Gabuzda, D. (JIVE) Cawthorne, T. (Central Lancashire) Pushkarev, A. (ASC)	Toroidal B fields in BL Lac objects. 0.4, 1.3, 2, 6 cm
BG144	Gabuzda, D. (Cork) Cronin, P. (Cork) Murray, E. (Cork)	Investigating the Toroidal B fields of BL Lac object jets. 0.4, 2, 6 cm.
BG147	Gallimore, J. (Bucknell) Cool, R. (Arizona) Thornley, M. (Bucknell)	Proper motions of H20 masers in a candidate protostellar disk. 1 cm
BG148	Gabauzda, D. (Cork) Pashchenko, I. (Moscow)	Probing the core regions of X-ray. 0.4, 2, 6 cm
BI030	Imai, H. (Kagoshima) Diamond, P. (Manchester)	Evolution of a water fountain in W43A. 1.3 cm.
BH118	Hough, D.H. (Trinity) Aars, C. (Trinity) Porcas, R. (MPIR, Bonn) Taylor, G. Zensus, J.A. (MPIR, Bonn)	Multi-frequency polarization imaging of five Jodrell Bank lobe-dominated quasars 0.4, 2, 6 cm
BJ036	Jorstad, S. (Boston) Marscher, A. (Boston) Yurchenko, A. (St. Petersburg)	BL Lac objects with high proper motion. 0.4, 0.7, 1.3, 2 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BJ048	Johnston, K. (USNO) Fey, A. (USNO) Ma, C. (NASA/GSFC) Gordon, D. (NASA/GSFC) Boboltz, D. (USNO) Kingham, K. (USNO) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) MacMillan, D. (Interferometrics) Petrov, L. (NASA/GSFC) Fomalont, E. Walker, R.C.	Geodesy/astrometry observations for 2004. 3.6 cm
BJ051	Jonker, P. (CfA) Chatterjee, S. (Cornell) Fender, R. (Amsterdam) Gaensler, B. (CfA) Nelemans, G. (IoA, Cambridge)	Milliarcsec scale jets in black hole X-ray transients. 0.4, 13 cm
BK107	Krichbaum, T. (MPIR, Bonn) Sohn, B. (MPIR, Bonn) Agudo, I. (IAA, Andalucia) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn) Ungerechts, H. (Massachusetts) Terasranta, H. (Helsinki)	Polarimetric monitoring of blazar 1633+382 after major flare. 0.7, 1.3 cm
BL104	Lobanov, A. (MPIR, Bonn) Roland, J. (IAP) Ros, E. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Cross-band monitoring of a flare in the VLBI core of 3C345. 0.7, 1.3, 2 cm
BL105	Lobanov, A. (MPIR, Bonn) Klare, J. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Zensus, J.(MPIR, Bonn)	Multi-frequency monitoring of the parsec scale jet in 3C345. 0.4, 2, 6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BL111	Lister, M. Aller, M. (Michigan) Aller, R. (Michigan) Cohen, M. (Michigan) Homan, D. Kadler, M. (MPIR, Bonn) Kellermann, K. Kovalev, Y. (Lebedev) Lobanov, A. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Vermeulen, R. (NFRA) Zensus, J. (MPIR, Bonn)	MOJAVE program. 2 cm
BLl118	Loinard, L. (UNAM) Mioduszewski, A.	Astrometric study of T Tau Sb. 0.4 cm.
BL124	Loinard, L. (UNAM) Mioduszewski, A. Rodriguez, L.F. (UNAM) Rodriguez, M. (UNAM) Torres, R. (UNAM)	Parralax and proper motions of young stellar sources in Taurus. 0.4 cm
BM203	Marr, J. (Union College) Taylor, G. Morris, A. (Union College)	Spectral study of CSO candidates 0026+346 and 1321+410. 1.3, 2, 3.6, 6, 18 cm
BM205	McIntosh, G. (Minnesota) Phillips, R. (Haystack)	Observations of the V=0, 1, and 2; J=1.0 SiO maser emission from Mira. 0.7 cm
BM207	Middelberg, E. (MPIR, Bonn) Brisken, W. Krichbaum, T. (MPIR, Bonn) Ly, C. (Arizona) Roy, A. (MPIR, Bonn) Walker, R.C.	Measuring the core shifts in M87 and NGC 4261. 0.7, 1, 2, 20 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BM209	Marcaide, J. (Valencia) Guirado, J. (Valencia) Perez-Torres, M. (IAA, Granada) Ros, E. (MPIR, Bonn)	Multi-wavelength absolute kinematics in S5 polar cap sample. 0.4 cm
BM211	Marscher, A. (Boston Univ.) Aller, M. (Michigan) Gomez, J. (IEEC) Jorstad, S. (Boston) McHardy, I. (Southampton)	Multi-frequency monitoring of the jets of selected blazars and radio galaxies. 0.7 cm
BM212	Marcha, M. (CAAUL) Caccianiga, A. (OAB, Milano) Polatidis, A. (MPIR, Bonn)	Accretion in low-luminosity AGN: A radio, UV, and X-ray variability study. 6 cm
BN021	Nagar, N. (Arcetri) Falcke, H. (MPIR, Bonn) Maoz, D. (Tel Aviv) Wilson, A. (Maryland)	Accretion in low luminosity AGN. 6 cm
BN026	Neff, S. (NASA) Ulvestad, J.	VLBA survey for AGN in galaxy mergers. 6 cm
BN027	Nagar, N. (Arcetri)	Multiple supermassive black holes in merger systems. 6 cm
BP114	Partridge, R. B. (Haverford) Cabanela, J. (St. Cloud State) Marr, J. (Union College)	VLBI structure of sources with inversed spectra at gigahertz frequencies. 2 cm
BR091	Romani, R. (Stanford) Brisken, W. Dodson, R. (ISAS) Manchester, R. (CSIRO)	PSR B1706-44's origin and kick from an astrometric proper motion. 6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BS096	Suda, H. (Tokyo) Honma, M. (NAOJ) Sasao, T. (NAOJ)	Phase referencing VLBA obs. of water maser source in the inner galaxy. 1.3 cm
BS133	Savolainen, T. (Tuorla) Bottcher, M. (Ohio) Raiteri, C. (INAF) Takalo, L. (Tuorla) Villata, M. (INAF) Wiik, K. (Tuorla)	Multi-frequency properties of blazar 3C 66A. 0.4, 0.7, 6, 13 cm
BS140	Shen, Z-Q. (ISAS, Japan) Lo, K. Y. Miyoshi, M. (NAOJ) Ho, P. (CfA) Zhao, J. (CfA) Tsuboi, M. (Ibaraki) Miyazaki, A. (Ibaraki) Tsutsumi, T. (NAOJ)	Monitoring the temporal variation in the structure of Sgr A*. 0.4 cm
BS143	Stockdale, C. (Marquette) Panagia, N. (STScI) Sramek, R. Van Dyk, S. (IPAC) Weiler, K. (NRL)	Late-time radio emission from SN 2001 0.4 cm
BS146	Sokoloski, J. (CfA) Brocksopp, C. (MSSL) Kaiser, C. (Southampton) Mioduszewski, A. Rupen, M.	Observations of radio jets from outbursting symbiotic stars. 0.4 cm
BT075	Tarchi, A. (MPIR, Bonn) Brunthaler, A. (MPIR, Bonn) Henkel, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Moscadelli, L. (Bologna) Chiaberge, M. (MPIR, Bonn)	Water megamaser in an FRII galaxy, 3C 403. 1.3 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BT076	Thorsett, S. (UC, Santa Cruz) Backer, D. (UC, Berkeley) Benson, J. Brisken, W. Chatterjee, S. (Cornell) Cordes, J. (Cornell) Fomalont, E. Golden, A. (Ireland) Goss, W. M. Kramer, M. (Manchester) Lazio, T. J.W. (NRL) Lyne, A. (Manchester) McKinnon, M. Vlemmings, W. (Cornell)	Astrometry of a nearby merging binary pulsar system. 6, 20 cm
BU026	Ulvestad, J. Gehrels, N. (NASA) Macomb, D. (Boise State) Michelson, P. (Stanford) Romani, R. (Stanford)	Multi-epoch imaging of recently identified EGRET blazars. 2 cm
BU029	Umana, G. (IRA, Noto) Buemi, C. (IRA, Noto) Leto, P. (IRA, Noto) Toscano, S. (Catania) Trigilio, C. (IRA, Noto)	VLA & VLBA observations of HR 1099 during a radio burst. 0.4, 6 cm
BV052	Voronkov, M. (CSIRO) Moscadelli, L. (Cagliari) Sylsh, V. (ASC)	Methanol and H20 masers in GL2789. 1.3, 2 cm
BV53	Chatterjee, S. (Cornell) Diamond, P.J. (Manchester) van Langevelde, H. (JIVE)	Parallax and proper motions of late-type stars. 20 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BW072	Wiik, K. (Tuorla) Savolainen, T. (Tuorla) Tornikoski, M. (Metsahovi) Valtaoja, E. (Tuorla)	Multi-wavelength monitoring of an intraday variable blazar. 0.7, 1.3, 6, 20 cm
BX005	Xu, Y. (Nanjing) Greenhill, L. (CfA) Menten, K. (MPIR, Bonn) Moscadelli, L. (Cagliari) Reid, M. (CfA) Zheng, X. (Nanjing)	Distance to the Persius Spiral arm. 2 cm
GG057	Gurvits, L. (NFRA) Pogrebenko, S. (JIVE) Avruch, I. (NFRA) Bignall, H. (JIVE) Campbell, R. (NFRA) Garrett, M. (NFRA) Lebreton, J. (ESA) vanKlooster, C. (ESA-ESTEC) Folkner, W. (JPL) Preston, R. (JPL) Romney, J. Bird, M. (Bonn)	VLBI and Doppler tracking of the Huygens Titan Probe. 13 cm

Personnel

NEW HIRES

Achermann, Cristobal	Research Associate, Junior	07/06/04
Ashton, Sylas	Electronics Engineer III	08/16/04
Baker, Andrew	Research Associate	09/03/04
Boyce, Edward	Research Associate, Junior	09/01/04
* Cheung, Chi "Teddy"	Research Associate	08/01/04
Fish, Vincent	Research Associate	09/01/04
Fleyshman, Grigoriy	Visiting Scientist	08/16/04
* Lacasse, Michael	Electronics Engineer III	07/19/04
Mastrantonio, Erin	Research Assistant	07/15/04
* McCarney, Benjamin	Research Associate, Junior	08/30/04
* Miller, Neal	Research Associate	09/01/04
Palmer, Patrick	Visiting Scientist	07/01/04
Ransom, Scott	Assistant Scientist	08/01/04

TERMINATIONS

Palmer, Patrick	Visiting Scientist	07/31/04

PROMOTIONS AND APPOINTMENTS

Bhatnagar, Sanjay	Associate Scientist	07/01/04
Brisken, Walter	Associate Scientist	07/01/04
Condon, James	Deputy Director	09/01/04
Hogg, David	Scientist	09/01/04
Lacasse, Richard	Electronics Engineer, Sr.	07/01/04
Mason, Brian	Associate Scientist	07/01/04
Moellenbrock, George	Associate Scientist	07/01/04
Norrod, Roger	Electronics Engineer, Sr.	07/01/04
Norville, Roy	Deputy Human Resources Manager	07/01/04
O'Neil, Karen	Associate Scientist	07/01/04
Plumley, Christine	Associate Business Manager	07/01/04
Scott, Richard	Electronics Engineer I	07/01/04
Sjouwerman, Lorant	Associate Scientist	07/01/04

*Rehire

Publications

The following preprints were received in the NRAO Charlottesville library during this reporting period authored by the NRAO staff or based on observations on an NRAO telescope.

ARGON, A.L.; GREENHILL, L.J.; MORAN, J.M.; REID, M.J.; MENTEN, K.M.; INOUE, M. The IC 133 Water Vapor Maser in the Galaxy M33: A Geometric Distance.

BECK, S.C.; GARRINGTON, S.T.; TURNER, J.L.; VAN DYK, S.D. MERLIN and VLA Observations of VII Zw 19: Distant Cousin of M82.

BHATNAGAR, S.; CORNWELL, T.J. Scale Sensitive Deconvolution of Interferometric Images I. Adaptive Scale Pixel (Asp) Decomposition.

BIETENHOLZ, M.F.; BARTEL, N.; RUPEN, M.P. The Location of the Core in M81.

BIETENHOLZ, M.F.; HESTER, J.J.; FRAIL, D.A.; BARTEL, N. The Crab Nebula's Wisps in Radio and Optical.

BROGAN, C.L.; GOSS, W.M.; LAZENDIC, J.S.; GREEN, A.J. OH (1720 MHz) Maser Search Toward the Large Magellanic Cloud.

BUSH, S.J.; WILCOTS, E.M. Neutral Hydrogen in the Interacting Magellanic Spirals NGC 4618/4625.

CARILLI, C.L.; WALTER, F.; BERTOLDI, F.; MENTEN, K.M.; FAN, X.; LEWIS, G.F.; STRAUSS, M.A.; COX, P.; BEELEN, A.; OMONT, A.; MOHAN, N. Radio Continuum Imaging of Far-Infrared-Luminous QSOs at $z > 6$.

CHAPMAN, S.C.; SMAIL, I.; BLAIN, A.W.; IVISON, R.J. A Population of Hot, Dusty Ultra-Luminous Galaxies at $z \sim 2$.

CHAPMAN, S.C.; SMAIL, I.; WINDHORST, R.; MUXLOW, T.; IVISON, R.J. Evidence for Extended, Obscured Starbursts in Submillimeter Galaxies.

CORNWELL, T.J.; GOLAP, K.; BHATNAGAR, S. The Non-coplanar Baselines Effect in Radio Interferometry.

COX, A.L.; SPARKE, L.S. Radio-Continuum Emission in Polar-Ring Galaxies.

FINKBEINER, D.P.; LANGSTON, G.I.; MINTER, A.H. Microwave ISM Emission in the Green Bank Galactic Plane Survey: Evidence for Spinning Dust.

Publications

GALLART, C.; STETSON, P.B.; HARDY, E.; PONT, F.; ZINN, R. Surface Brightness and Stellar Populations at the Outer Edge of the Large Magellanic Cloud: No Stellar Halo Yet.

GARLAND, C.A.; PISANO, D.J.; WILLIAMS, J.P.; GUZMAN, R.; CASTANDER, F.J. The Nature of Nearby Counterparts to Intermediate Redshift Luminous Compact Blue Galaxies I. Optical/H I Properties and Dynamical Masses.

GELFAND, J.D.; LAZIO, T.J.W.; GAENSLER, B.M. A Wide Field, Low Frequency Radio Survey of the Field of M31: I. Construction and Statistical Analysis of the Source Catalog.

HARRIS, D.E.; MOSSMAN, A.E.; WALKER, R.C. The X-ray Jet of 3C 120: Evidence for Non-standard Synchrotron Spectrum.

HELMBOLDT, J.F.; WALTERBOS, R.A.M.; BOTHUN, G.D.; O'NEIL, K.; DE BLOK, W.J.G. Star Formation in HI Selected Galaxies I: Sample Characteristics.

HOLLIS, J.M.; JEWELL, P.R.; LOVAS, F.J.; REMIJAN, A. Green Bank Telescope Observations of Interstellar Glycolaldehyde: Low-Temperature Sugar.

JOHNSON, K.E.; INDEBETOUW, R.; WATSON, C.; KOBULNICKY, H.A. Revealing the Young Starburst in Haro 3 with Radio and Infrared Imaging.

JORSTAD, S.; MARSCHER, A. The Highly Relativistic Kiloparsec-Scale Jet of the Gamma-Ray Quasar 0827+243.

KEENEY, B.A.; MOMJIAN, E.; STOCKE, J.T.; CARILLI, C.L.; TUMLINSON, J. Absorption Line Study of Halo Gas in NGC 3067 Toward the Background Quasar 3C 232.

KOGAN, L. Another Algorithm for Phased Array Null Formation.

MUNDELL, C.G.; JAMES, P.A.; LOISEAU, N.; SCHINNERER, E.; FORBES, D.A. The Unusual Tidal Dwarf Candidate in the Merger System NGC 3227/6: Star Formation in a Tidal Shock?

O'DEA, C.P.; GALLIMORE, J.; STANGHELLINI, C.; BAUM, S.A.; JACKSON, J.M. A Search for Molecular Gas in GHz Peaked Spectrum Radio Sources.

O'NEIL, K. New Reference Galaxy Standards for H I Emission Observations.

O'NEIL, K.; BOTHUN, G.; VAN DRIEL, W.; MONNIER RAGAIGNE, D. A New HI Catalog of Low Surface Brightness Galaxies Out to z=0.1. Tripling the Number of Massive LSB Galaxies Known.

Publications

O'NEIL, K.; SCHINNERER, E. Properties of Moledular Gas in Massive Low Surface Brightness Galaxies, Including New 12CO Observations of Three Malin 1 'Cousins'

OJHA, R.; FEY, A.L.; JAUNCEY, D.L.; LOVELL, J.E.J.; JOHNSTON, K.J. Milliarcsecond Structure of Microarcsecond Sources: Comparison of Scintillating and Non-scintillating Extragalactic Radio Sources.

OJHA, R.; FEY, A.L.; LOVELL, J.E.J.; JAUNCEY, D.L.; JOHNSTON, K.J. VLBA Snapshot Imaging Survey of Scintillating Sources.

REID, M.J.; BRUNTHALER, A. The Proper Motion of Sgr A*. II. The Mass of Sgr A*

SCHINNERER, E.; CARILLI, C.L.; SCOVILLE, N.Z.; BONDI, M.; CILIEGI, P.; VETTOLANI, P.; LE FEVRE, O.; KOEKEMOER, A.M.; BERTOLDI, F.; IMPEY, C.D. The VLA-COSMOS Survey: I. Radio Identifications from the Pilot Project.

SHUKLA, H.; YUN, M.S.; SCOVILLE, N.Z. Dense Ionized and Neutral Gas Surrounding Sgr A*

TURNER, B.E.; PETRIE, S.; DUNBAR, R.C.; LANGSTON, G. A Search for MgNC and AINC in TMC-1: The Status of Metals in Dark Cloud Cores.

UDOMPRASERT, P.S.; MASON, B.S.; READHEAD, A.C.S.; PEARSON, T.J. An Unbiased Measurement of H(o) through Cosmic Background Imager Observations of the Sunyaev-Zel'dovich Effect in Nearby Galaxy Clusters.

VANDEN BOUT, P.A.; SOLOMON, P.M.; MADDALENA, R.J. High Redshift HCN Emission: Dense Star-Forming Gas in IRAS F10214+4724.

YUSEF-ZADEH, F.; HEWITT, J.; COTTON, W. A lambda 20cm Survey of the Galactic Center Region I: Detection of Numerous Linear Filaments.

ZAPATA, L.A.; RODRIGUEZ, L.F.; KURTZ, S.E.; O'DELL, C.R.; HO, P.T.P. A Cluster of 1.3 Centimeter Continuum Sources in OMC-1 South.