NATIONAL RADIO ASTRONOMY OBSERVATORY

Quarterly Report

April – June 2004

Table of Contents

Executive Summary

ALMA

Two key positions in the Joint ALMA Office (JAO) have been filled. Rick Murowinski has been appointed ALMA Project Engineer and will be moving to Santiago in the fall. Anthony Beasley has been appointed ALMA Project Manager and will officially join the project in September. Office space has been secured for ALMA activities in Santiago. Approximately 800 m^2 will accommodate the staff of the JAO and the executives for three years. A Request for Proposal (RFP) has been issued for the first major civil construction contract at the Array Operations Site (AOS). Proposals for the production antenna procurement were received April 1. Review of the proposals submitted to AUI / NRAO is underway, and the scheduled start of the production contract is September 15, 2004.

EVLA

The project held critical design reviews of its Local Oscillator, Intermediate Frequency and Data Transmission system designs. The L-band feed was tested on an antenna range and was determined to perform within specification. First fringes were obtained on the test antenna at L-band. A new proposal to spend the Mexican funds is being considered under which they would pay the NRAO as a sole source entity to build FE receivers. Outfitting of the second EVLA antenna (VLA antenna # 14) commenced. The Canadian Partners are in negotiation with two vendors for the new correlator chip.

Green Bank Telescope

The Green Bank Telescope (GBT) continued in routine, productive operation for well over 50% of the available time generating a wide range of excellent scientific results, including the detection of HCN in a z = 2.3 galaxy, the detection of the first new interstellar molecules discovered by the GBT, and new results on the binary double pulsar. The Ease of Use project made significant progress and completed the beta version of the new Observing Application Programming Interface (API). The Observing API project builds on the lessons learned from the current observer interface, GO, and is consistent with the ALMA scheduling block definition, allowing compatibility with future ALMA software development. This beta release will generate much needed feedback from staff astronomers. Work on the azimuth track project continued. Results from the finite element analysis successfully explained the fretting wear and bolt breakage problems, but did not explain the wear plate fatigue mechanism. We are currently focusing efforts on this fatigue problem, the most important remaining issue to understand prior to settling on an azimuth track problem remedy. The 26 – 40 GHz (Ka-band) receiver was completed and performed well when installed on the GBT for engineering tests in April. Astronomical commissioning will resume in the fall and the Ka-band receiver is expected to be ready for scientific use by the end of 2004.

Executive Summary

Very Large Array & Very Long Baseline Array

The 9th Synthesis Imaging Summer School was held at NRAO and on the campus of New Mexico Tech. This version was the most heavily attended such school held yet, with 148 attendees from more than a dozen countries. As usual, the summer school combined a rigorous course of lectures on interferometry theory with practical data-reduction tutorials using VLA, VLBA, and millimeter interferometer data.

An external VLA/VLBA Large Proposal Committee met to evaluate five "large" proposals for the VLA and VLBA. Approximately 500 hours of VLA time was awarded out of more than 2000 requested, while all the requested time of 336 hours was awarded to the single VLBA large proposal.

Approximately 20 NRAO staff members moved into temporary quarters in a new office building under construction on the New Mexico Tech campus. A series of succeeding office moves within the Array Operations Center is enabling the relief of severe overcrowding in the Electronics labs used for prototyping and testing for both EVLA and ALMA. This will allow both projects to continue with their development efforts expeditiously and with increased safety.

The azimuth bearing was replaced on VLA antenna 14, bringing to eight the total number of such bearings replaced over the history of the VLA. Several more bearings purchased late in 2003 were received, and will enable the replacement of three more bad bearings in 2004 and 2005.

Work was initiated on an operations plan for the VLA during its multi-year transition to the EVLA over the next five years. Specific milestones for this plan, including a preliminary schedule for some new scientific capabilities, are expected to be developed during the third quarter of 2004.

A decision was made to severely curtail maintenance spending on the operational VLBA tape recording systems. This decision will save money that can be spent on purchasing Mark 5 disk-based systems, and the associated disk media required for the new systems. This will enable reduced maintenance costs and higher bandwidth performance for the VLBA in the future. The immediate impact of the savings is an acceleration in the plan to implement the Mark 5 system in the VLBA. We now expect to have Mark 5 fully operational (including sufficient disk media and correlator playback) for 3 of the 10 VLBA stations by the end of August 2004; this compares to our previous plan of having two stations operational by the end of 2004.

Executive Summary

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 work has demonstrated performance meeting specifications. The ALMA local oscillator chains are meeting the requirements for phase noise, phase drift, sideband noise, and power output for all bands. Design of a new 385-500 MHz SIS mixer is making good progress, and HEB mixer investigations for 600-720 GHz are close to the testing phase. The ALMA correlator is making 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 is 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

As a result of focused attention on security, the NRAO continues to be almost completely spared from major virus outbreaks. All sites are now cautious about verifying operating-system patches and anti-virus protection on non-NRAO systems such as visitors' laptops, and the automated patching processes established by the Common Computing Environment (CCE) group for both Windows and Linux are functioning well.

The CCE group has as its goal to ensure that all sites provide a standard configuration of operating systems, network services, applications software availability, and user interfaces. There has been significant progress towards these goals in the last few months.

The deployment of the network and telephony infrastructure in the NRAO Technical Center in Charlottesville has been started.

Education and Public Outreach

Both community and media outreach did well this quarter with a VIP tour of Green Bank by prominent Charlottesville residents, a major regional planetarium conference coming to Charlottesville to learn about the NRAO, and significant local and regional news reports on the NRAO and its research results. VLA and Green Bank Gift shops continue to outperform original projections. A NASA IDEAS funded teacher workshop was held in Socorro in June, laying the foundations for an ongoing 2-week astronomy class that will be offered bi-annually at New Mexico Tech.

Executive Summary

Environment, Safety and Security

Environment, Safety, and Security (ES&S) participated in the development of the ALMA project by review of key construction and procurement documentation. The construction activities at the ALMA ATF site have been replaced by operational safety issues and ES&S continues to provide oversight. At the VLA an Automated External Defibrillator (AED) was received from a grant applied for in December of 2003. The Wellness Program provided blood sampling to interested employees at the Green Bank site. Also at Green Bank, the high angle rescue team practiced their rescue skills on the GBT. The security surveillance cameras were tested for RIF and the mitigation process initiated with the use of screened camera dome covers.

Science Highlights

Very Large Array

The first major data release took place for the VLA Low-frequency Sky Survey (VLSS), a 74 MHz high-resolution survey of the entire sky north of -30 degrees declination. This region is being imaged with a resolution of 80 arcseconds. Among other scientific goals, the VLSS should result in new samples of radio sources with extremely steep spectra, which may include radio galaxies at very high redshift, relics of mergers between clusters of galaxies, and millisecond pulsars. The first data release, covering about 50% of the planned sky area, can be found via the VLSS web page at *http://lwa.nrl.navy.mil/VLSS/*. The VLSS will be completed with further observations in the VLA B and BnA configurations in 2005 and 2006.

Very Long Baseline Array

Global VLBI Reveals Youngest Stellar Corpse. Ongoing studies of Supernova 1986J in NGC 891 have discovered a bright, compact radio component at the center of the expanding shell. This bright component has only recently become visible. New observations made using the VLBA, the GBT, the VLA and the EVN, indicate that the central component has an inverted radio spectrum different from the shell. The new component likely is either the result of accretion onto a black hole or a pulsar wind nebula. This result provides evidence for the first association of a compact object with a modern, observed supernova and makes the black hole or neutron star by far the youngest known.

Investigators: M. Bietenholz and N. Bartel (York U.) and M. Rupen (NRAO).

Green Bank

Detection of HCN in a z=2.3 Galaxy. Hydrogen cyanide (HCN) emission has been detected in the z=2.2857 source IRAS F10214+4724 using the GBT. This is only the second detection of HCN in a high redshift galaxy. HCN is a signpost of star formation, and F10214 clearly contains a starburst that contributes, together with its embedded quasar, to its overall infrared luminosity. The peak emission of the detected spectral line is about 0.45 mJy with a noise level of ~0.090 mJy. A new technique for removing spectral baselines in the search for weak, broad emission lines was utilized for this project.

Investigators: P. A. Vanden Bout (NRAO), P. M. Solomon (SUNY Stony Brook), R. J. Maddalena (NRAO).

New Interstellar Molecules detected with the GBT. The GBT has been used to detect two new interstellar molecules, propenal (CH_2CHCHO) and propanal (CH_3CH_2CHO). These are the first new molecules detected with the GBT. These molecules were detected in the star-forming region Sagittarius B2 (N). The GBT was also used to observe the previously reported molecule propynal (HC_2CHO). These molecules differ only in the number of hydrogen atoms present. The presence of these three molecular

species in Sgr B2 (N) suggests that simple hydrogen addition on interstellar grains may account for their formation. The Sgr B2 (N) cloud appears to have ample energy sources to allow such grain reactions to proceed. This result suggests that successive hydrogen addition may be an important formation pathway for complex, interstellar molecules.

Investigators: J. M. Hollis (NASA-GSFC), P. R. Jewell (NRAO), F. J. Lovas (NIST), A. Remijan (NRC & NASA-GSFC), and H. Mollendal (University of Oslo).

ALMA

The official bimonthly reports to the NSF on the ALMA Project can be found on the NRAO web site at *http://www. alma.nrao.edu/news/*. A summary of significant items during the period of this report is given below.

Two key positions in the Joint ALMA Office (JAO) have been filled. Rick Murowinski, formally of the Hertzberg Institute for Astrophysics, has been appointed ALMA Project Engineer. He is currently working from Victoria Canada and will be moving to Santiago in the fall. Anthony Beasley, currently project manager for the Combined Array for Research in Millimeter-Wave Astronomy (CARMA), has been appointed ALMA Project Manager. He will officially join the project in September.

Office space has been secured for ALMA activities in Santiago. Approximately 800 m^2 will accommodate the staff of the JAO and the executives for three years. The space will be available for occupancy in November 2004. A permanent facility is planned to house the staff required for ALMA operations in Santiago.

A Request for Proposal (RFP) has been issued for the first major civil construction contract at the Array Operations Site (AOS). Construction for the AOS Technical Building will start in September 2004.

Proposals for the production antenna procurement were received 1 April 2004. Review of the proposals submitted to AUI/NRAO are underway among three committees; The Joint Technical Evaluation Team (JTET), the Business Evaluation Committee (BEC) and the Contract Selection Committee (CSC). The JTET is composed of members from both NRAO and ESO and is conducting a technical review all proposals received by both Executives. The JTET will also receive the report of the Antenna Evaluation Group (AEG) on the measured performance of the two prototype antennas. The BEC is conducting business due diligence and reviewing the business and management aspects of the proposals submitted to AUI/NRAO. Finally, the CSC will receive the reports of the JTET and BEC, open the financial offers and make a recommendation to the AUI President and NRAO Director. The scheduled start of the production contract is September 15, 2004.

Expanded Very Large Array

Expanded Very Large Array Highlights

The project held critical design reviews of its Local Oscillator, Intermediate Frequency and Data Transmission system designs. The L-band feed was tested on an antenna range and was determined to perform within specification. First fringes were obtained on the test antenna at L-band. A new proposal to spend the Mexican funds is being decided on whereby they would pay the NRAO as a sole source entity to build FE receivers. Outfitting of the second EVLA antenna (VLA antenna # 14) commenced. The Canadian Partners are in negotiation with two vendors for the new correlator chip.

Expanded Very Large Array Milestones

Milestones	Original Date	Revised Date	Date Completed
M301 converter module ready for MIB	11/14/03	04/06/04	04/01/04
30 GHz receiver design ready for drafting	11/14/03	04/15/04	04/12/04
Install 1.4 GHz feed on ant 13	04/15/04		04/14/04
New Control Bldg chillers installed	04/30/04		04/14/04
Electrical power survey of test antenna	03/22/04	04/09/04	04/15/04
VLA Control Bldg. HVAC chiller replacement	04/16/04		04/16/04
3 GHz feed assembled & laminated	04/16/04		04/16/04
C-band OMT design/analysis	03/16/04	04/16/04	04/19/04
Start 2nd test antenna outfitting	03/22/04	04/15/04	04/20/04
Internal software design review	04/22/04		04/22/04
Power supply board layout for P301 & P302	12/19/03	04/20/04	04/22/04
30 GHz feed tests complete	05/04/04		04/30/04
MIB software ready for FRM interface	01/26/04	04/30/04	04/30/04
Master LO functional	02/25/04	04/23/04	05/03/04
New shielded room planning session	05/06/04		05/06/04
Level 2 schedule reviews	05/07/04		05/07/04
Preliminary design on non-blind-mate module connector	05/07/04		05/07/04
Slot identification boards installed on test racks	05/07/04		05/07/04
2nd L305 module ready for software	04/30/04		05/10/04
MIB slot identification software written	04/30/04		05/14/04
Start 3 GHz receiver assembly	05/16/04		05/16/04

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
FRM MIB interface ready for software	05/20/04		05/20/04
LO, IF & Fiber Optic/DTS system CDR	03/03/04	05/21/04	05/21/04
Power supply board (P301&P302) internal design review	05/24/04		05/24/04
T302 L,S,C converter ready for test antenna	12/19/03	04/16/04	05/28/04
EVLA Computing Overall Design	03/01/04	06/01/04	06/01/04
Functional and technical overall EVLA M&C architectural design	03/01/04	06/01/04	06/01/04
WBS updates	04/29/04		06/08/04
Overall software design completion	06/08/04		06/08/04
M301 hardware ready for MIB software	06/09/04		06/09/04
1.4 GHz receiver usable with L/S/C converter	06/10/04		06/10/04
Vertex room mockup internal review	04/26/04		06/24/04
U/X converter ready for test antenna	11/14/03	07/12/04	
LO/IF switches ready for test antenna	05/06/04	07/12/04	
Complete Part 1 hardware bench integration	03/03/03	07/16/04	
Check for interference and bandpass shapes: 328MHz, 22 & 45 GHz	03/15/04	07/16/04	
Check for interference and bandpass shapes 8, 22 & 45 GHz	12/19/03	07/16/04	
Receiver stability tests: 8, 22 and 45 GHz	12/19/03	07/16/04	
Verify linearity of RF designs – receiver to correlator	05/27/04	07/16/04	
Fabricate NRAO Q-band MMIC post amplifier	07/16/04		
Replace fiber watch spring on antenna 13	07/16/04		
Software requirements for real-time system	08/29/03	07/21/04	
Multi frequency observing - L & X	07/21/04		
*K & Q-band receivers usable - antenna 13	07/22/04		
Bench integration test racks populated	05/07/04	07/23/04	
2nd F320 module assembled and tested	07/21/04		
75/328 MHz converter module ready for test antenna	10/24/03	07/30/04	
Routine test observing	05/13/04	07/30/04	
Power supply board (P301 & P302) assembled & tested	07/30/04		
2 controllable IF's in antenna 13	07/30/04		
F320 FE transition module w/MIB & ICD ready for software	12/09/04	08/05/04	
3 GHz feed tested	05/14/04	08/13/04	
Cold storage building ready	06/18/04	08/30/04	

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
Move antenna 13 to array	08/05/04		
Move Fiber Lab to CB annex	08/13/04		
Racks and fiber installed on antenna 14	08/16/04		
Install C-band feed on antenna 14	08/31/04		
1st DTS module w/ transponder	08/31/04		
Two F317 modules w/ MIB tested and ready for antenna	09/08/04		
First fringes on antenna 14	09/09/04		
4 IF's on antenna 14 working	09/13/04		
P, L, X, K & Q-band receivers usable - antenna 14	09/13/04		
Monitor &Control CDR	09/15/04		
FY2005 budget plan	09/16/04		
Move 2nd test antenna (14) to array	09/27/04		
Start 1st production antenna overhaul	09/30/04		

Management

The additional $4M in accelerated funding was received and allocated to the project's level 3 accounts. The procurement of several large orders of critical electronic and mechanical components has started. Review meetings with the project leaders were held to update the project WBS and schedule.

A new development with the Mexican Partner has arisen to possibly use their contributed funds to buy receivers from NRAO, with NRAO being the sole source. CONACyT, the Mexican counterpart to the NSF and administrator of these funds seem positive about this sole source possibility. As a first step toward this proposal, NRAO sent technical specifications, cost data and a justification statement to CONACyT (who will forward the proposal to the World Bank for its approval). Feedback from CONACyT on the proposal is expected soon.

Systems Integration

A Critical Design Review (CDR) was held for the EVLA LO, IF and Fiber optics systems in May. Feedback from the review committee has been very positive and indicates that the electronics design is progressing very well. Presentations and the Review Panel Report from the CDR are available on-line (*http://www.aoc.nrao.edu/evla/admin/reviews/lo-if-fo_cdr/lo-if-fo_cdr.html*). Most of the prototype electronics modules are now functioning in the EVLA test racks. Design and prototyping of the more integrated, second generation modules is well underway. These modules are essentially the prototypes for the production designs that will be used in the array.

Expanded Very Large Array

Interferometric fringes have now been obtained using the new L-band feed and associated new LO/IF electronics. In addition to the hardware used in last quarter's X-band fringe test, this has allowed us to test the functionality of the L-band feed, T302 LSC converter and the L301 synthesizer. The tests were completed using an existing L-band receiver from the VLA mated to the new EVLA feed.

The new DC power supply PCB's have been received and are currently being prepared for testing. Updated DC distribution PCB's have been designed and will be sent for manufacturing in July. Pre-production prototypes of hardware for all of the LO/IF module were received in May. The parts of these modules have been test fitted and assembled. Several required changes have been identified and final drawings are nearing completion.

Civil Construction

The VLA Control Building's new chiller installation was completed. The chillers have been operational under load since April 16, 2004. In addition to cooling the Control Building, the chillers will provide the chilled water source to the shielded room of the WIDAR correlator. The VLA Control Building Annex has been remodeled for relocation of the Fiber Optics lab. Soon after the lab moves to its new space, preparations for the new shielded room will begin. To store the project's bulk production materials and supplies a new steel storage building was ordered. The foundation work for the steel structure has started. Building erection will begin shortly after foundation work is completed. Key milestone dates were established in May for the relocation of the VLA Modcomp computers and start of the new Shielded Room.

Antenna

The overhaul and EVLA outfitting of the second EVLA antenna started. The antenna, which first required an azimuth bearing replacement, is now being structurally modified to accommodate the EVLA designed installations. As a first step to resolve cooling issues inside the feed cone of antenna 13, skirt insulation was added to improve temperature control.

Front End

The large (16 ft long, 700 lb) L-band feed was tested on an antenna range at Composite Optics in San Diego and was determined to perform within specification. This confirms the validity of both the design and the laminated "band and ring" fabrication technique. The feed has been successfully installed on 13, the first test antenna. Refinements to the design of the coaxial probes used in the broad band 1-2 GHz Ortho Mode Transducer (OMT) were made and are being tested. The new C-band feed has been fabricated and will be shipped to MIT soon for beam pattern measurements. The cold-plate of the new C-band receiver has been assembled and the drawing package is undergoing a final revision. The EVLA Test Antenna is now equipped with cooled L, X, K & Q-band receivers and the F-Rack required for the control electronics has been installed. The blocks for the new Ka-band Downconverter prototype module

have been fabricated at the VLA Machine shop. The blocks for the first pair of NRAO Q-band post-amps have also been fabricated and an attempt at the micro-assembly and wire-bonding of the first MMIC-based multifunction module will start soon. The new Front-end Card Cage design has entered the prototype stage. RFQ's and purchase orders for 102 cold-heads and orders for parts to build 28 compressors are being placed. Work continues on the development of an antenna test range for the VLA site with the completion of the software for controlling the transmitter and receiver. A design for a programmable gain-slope equalizer has been proposed that should allow the entire RF & IF system to comply fully with the EVLA gain flatness specification.

Local Oscillator (LO)

First fringes were obtained at L-band. The next generation synthesizers are under construction and are about 40% complete. Preparations are underway to replace the RF section of the synthesizers with an RF module saving the project about $500K. The software for the synthesizers underwent much refinement. A sampling mixer circuit design has been completed but not tested. Second versions of modules L305, L350, L351, and L352 have been completed. Testing of the round trip phase system using 22 km of fiber is underway. Another design approach for the round-trip phase system is actively being sought to see if better performance can be obtained. The phase monitor circuit has been integrated and tested successfully in the L353.

Fiber Optics

The new 8-bit digitizer board design is complete. The 8-bit digitizer board and its Power Supply board in the Digital Transmission System (DTS) module are laid out and ready for assembly as soon as parts arrive. Feedback from the CDR reviewers indicated the DTS is in good shape and production can proceed with the exception of the half-transponder digital transmitter, which needs to be fully tested. Production quantities of all components have been ordered only for the deformatter board. Production quantities of some components have been ordered for the new 8-bit digitizer design. The earlier formatter board with discrete optical components will be replaced by the half-transponder formatter board. The half-transponder replaces all of the discrete optical components with a single RFI tight module.

The splicing of buried fiber along the array arms continues and twelve additional station pad boxes were placed in the array. An LO signal optically transmitted through 22 kilometers of array fiber was successfully recovered. Fiber cables were installed in the VLA Control Building between the MC bulkhead and the Ethernet network switch; the 1st floor termination and MC patch panel; the termination room and IF bulkhead; and between the demultiplexer and deformatter in the correlator room. The assembly of fiber cables for the 2nd test antenna (14) and replacement of the revised fiber watch spring on antenna 13 was started. An Optical Fiber Communication plan was written and is being reviewed for addition to the safety program.

Expanded Very Large Array

Intermediate Frequency System

Three connectorized downconverters have been completed and are under MIB control. A fourth downconverter is under construction. This converter is using integrated components and will be manually controlled. Various test circuits for the integrated version have been constructed and are being tested. Vendor-supplied prototypes of the UX converter were delivered. The coaxial version of the UX converter has been assembled and is ready to install on antenna 13. The first LSC and 4P Band converters have been constructed and tested. The first M301 is still under construction and some software has been developed for it.

Correlator

The Canadian Partners (Herzberg Institute for Astrophysics) are negotiating with two separate bidders for the new correlator chip to determine the best company to design and fabricate the chip. Small study contracts have been awarded to both companies to enable them to propose the most appropriate combination of chip technology and chip power consumption. Current power consumption estimates suggest that it will probably be necessary to use liquid cooling in some correlator racks. The impact of this new requirement on the design of the new correlator room in the VLA Control Building is being studied.

Monitor and Control (M/C)

In the area of MIB/module software, programming for the various module types continued. Additionally, the generic MIB framework software was enhanced and refined in several respects including the parsing and execution of commands, memory utilization, and the loading of boot images via Ethernet. Discussions are ongoing to come up with a solution for the MIB's slot identification scheme.

Data Management and Computing

A 'Distributed Objects Communications Team' was formed. Its charge is to formulate requirements on communications between EVLA software components, and assess the suitability of several alternatives to this issue.

The design team, charged with developing and overall end-to-end design for the EVLA software system, continued its activities. The third and final internal review took place in April. Between that date and June 14, the emphasis shifted to aligning the overall EVLA software design with the formalism and models developed in parallel by the NRAO-wide e2e oversight committee. A review by that committee took place June 14; though at the time of writing this report is not out yet, preliminary comments have been very encouraging. The next step is to move the design to the subsystem level with intention to have an overall software design review with participation from outside NRAO in the fall of 2004.

Green Bank Telescope

Green Bank Telescope Highlights

Development for the beta version of the new Observing Application Programming Interface (API) for the GBT was completed in the second quarter and the beta system is scheduled for release on July 9, 2004. The Observing API is being developed as part of a project to support execution of observations via scheduling blocks. A scheduling block contains project metadata, observing constraints, source information, and observing scripts, which allows them to be archived and managed as comprehensive descriptions of the observer's intent. The Observing API is used to build the observing script portion of the scheduling block. The Observing API project builds on the lessons learned from the current observers interface, GO, and is consistent with the ALMA definition of a scheduling block, to allow compatibility with future ALMA software development.

The specific purpose of the beta release is twofold. First, it will generate much needed feedback from staff astronomers. Second, the exercise of implementing observing procedures will expose the strengths and weaknesses of a new observing specification language. This approach will allow the enhancement of the system with user-defined procedures, increase robustness, introduce command-line interaction, facilitate general maintenance, improve reliability, and support integration into telescope scheduling. Further details on the Observing API are now available on the Green Bank wiki at Data.ObservingAPIBeta.

GBT Antenna & Operations

Milestones	Original Date	Revised Date	Date Completed
Complete Phase II of track analysis	10/31/03	08/01/04	
Complete development of new rail concepts	12/31/03	09/15/04	
Hold panel review meeting	01/31/04	10/15/04	

GBT Electronics

Milestones	Original Date	Revised Date	Date Completed
Spectrometer Upgrades			
Cross-correlation/poln. test fixture designed	01/01/04	08/01/04	
Cross-correlation/poln. test fixture constructed	03/01/04	09/01/04	
Begin polarization mode checkouts	06/01/04	09/01/04	
LTA redesign (engineering only)	04/01/04	08/01/04	
Sampler distributor redesign (engineering)	08/01/04	On Hold	
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
Outdoor range rotator	04/15/04		04/15/04
Receiver Turret Adapter	04/09/04		04/05/04
Penn Array Optics Tower	04/09/04		04/07/04
EVLA 5 Slot Bins (20)	06/26/04		06/09/04
ALMA LO Frame Assemblies(8)	07/30/04		
GBT RFI Antenna Mount	10/29/04		
Test Building Receiver Handler	10/15/04		

GBT Software & Computing

Milestones	Original Date	Revised Date	Date Completed
M&C v4.3	05/17/04		05/19/04
M&C v4.4	06/30/04		06/30/04
Deprecate IARDS	03/31/04	08/15/04	
First Scheduling Block Executed	03/31/04	07/09/04	
Complete GBT High-Level e2e Models	06/30/04	07/31/04	

GBT Projects

Milestones	Original Date	Revised Date	Date Completed
PTCS			
Surface Efficiency Improvements	04/30/04		04/30/04
Demonstration of pointing compensation for wind effects	06/30/04		06/30/04
Identify 1" level contributors to pointing error	09/30/04		
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	
Production Release of HLAPIs & Online Filler	03/31/04	09/30/04	
Beta Release of GO replacement	12/31/03	08/15/04	
Data Handling			
Generate requirements for imaging	12/31/03	09/01/04	
Analysis Conceptual Design Review (In-Progress Software Review)	02/09/04	TBD	
Spectral Baselines			
Begin installation of IF fixes	01/01/04	06/01/04	06/10/04
Conduct experiments to characterize Q band baselines	08/01/04		
IF Temperature stability experiments	08/01/04		
Ka-band (1 cm Rx)			
Complete assembly of common MM converter prototype and evaluate performance.	01/01/04		04/15/04
Complete assembly of 1 cm receiver	11/01/03	04/01/04	04/01/04
Test 1 cm receiver in laboratory, work out any problems	01/01/04	04/15/04	04/15/04
Penn Array Receiver			
Detectors Delivered to Penn	5/17/04	09/15/04	
Full Lab integration at Penn	9/6/04	10/01/04	
GBT Commissioning	2/21/05		
3mm Receiver (POSTPONED)			
Restart Project	11/15/03	On Hold	
Revise Project Plan	12/01/03	On Hold	
Prepare Budget request for FY2004	12/31/03	On Hold	

Green Bank Telescope

Milestones	Original Date	Revised Date	Date Completed
Caltech Continuum Backend			
Hold CDR in Green Bank	12/15/03	05/14/04	05/14/04
Construction and lab testing complete	08/27/04	08/27/04	
Commission on GBT	09/06/04	09/17/04	

GBT and Green Bank Overview

The GBT continued in routine, scientific operation during the second quarter. Observations for refereed observing proposals were scheduled for well over 50% of total time (on a 24 hour basis), with the remaining fraction used for regular maintenance and for commissioning tests for new instruments and development projects. The second quarter was extremely productive scientifically and saw the submission of some notable results to journals. Papers submitted during the quarter included results on the binary double pulsar, detection of HCN in a z=2.3 galaxy, and detection of the first new interstellar molecules found with the GBT.

Good progress was made on the Ease of Use project which aims to make the GBT more convenient to configure and use for observations. During this quarter, coding and testing for the beta release of the command line system was completed, and release was scheduled for 9 July. Further development, including full implementation of the scheduling block concept and development of a graphical user interface will continue in the upcoming quarter.

Following discussions with specific GBT users and with the Visiting and Users Committees, we have decided to implement an interactive data reduction system for basic single dish reduction in the commercial development package, IDL. IDL is a popular and familiar package among astronomers and allows rapid development and easy extension of capabilities. This package will meet the short-term, interactive data reduction needs of GBT single dish observers. Longer-term development of pipeline data reduction and end-to-end proposal handling is being coordinated with NRAO-wide initiatives.

Work on the azimuth track project continues. Results from the finite element analysis were received and were successful in explaining the fretting wear and bolt breakage problems, but did not explain the wear plate fatigue mechanism. We are presently focusing efforts on this fatigue problem as the most important remaining issue to understand before settling on a remedy for the track problems. A possible sample of the original wear plate stock has been located, and we are in the process of investigating its metallurgical properties. More analysis of the effects of wear plate loading is also planned.

GBT structural inspections resumed in June and will be carried out through the summer. This summer's inspections will focus on the backup and alidade structures. Repairs of the defects found in the elevation axle were carried out in May. It was found that the cracks in the welds were shrinkage cracks

from the original weld work and were not caused by fatigue. Some of the cracks were repaired and others will be monitored for change. This does not appear to be a significant issue, however.

The 26-40 GHz (Ka-band) Receiver was completed and installed on the telescope for initial engineering tests in April. Although only limited test time was available, the receiver appeared to be performing very well. Additional work on the receiver and the associated Millimeter-wave Down-converter will be completed over the summer, and astronomical commissioning will resume in the fall. The receiver should be ready for scientific use by the end of the year.

Azimuth Track

Work on analyzing the various failure mechanisms continues, with most effort focused on the wear plates. The models developed by the contractor have not captured the mechanisms causing the cracking of the plates. This effort will continue into the next quarter.

We have also pursued the metallurgy of the plates, and may have located some of the original material from the plates cut off during manufacture. If this proves correct, it will give us valuable insight as to whether the material was inadequate in the beginning or deteriorated during service.

We have replaced several of the cracked plates during this quarter, and continue to check for cracked bolts and to shim the plates as needed to manage wheel tilts.

We also replaced the wear plate over the modified joint. It is being examined metallographically to determine the nature of the defects found by ultrasonics. This work is being done by Bodycote Materials Laboratory in Chicago. To date, an explanation of the defects has not been found. The weld itself was inspected again after a year's service (about 28,000 wheel passes) and is satisfactory.

Telescope Operations Activities

We began our summer maintenance season May 17. The first activity completed was investigation and repair of some of the defects in the left elevation bearing stub shaft. We confirmed the nature of the cracks to be shrinkage cracks from manufacture, and repaired two in the high stress areas. We will continue to periodically monitor the remainder of the indications and address them if we see a change.

Structural inspection of the alidade and one-half of the back-up structure began in June. The contractor is Modjeski and Masters from Mechanicsburg, PA. A bowed angle brace and cracked gusset plate weld were found along the walkway on the elevation bearing level, and were temporarily repaired. A series of strain gauge tests were completed and are being compared to results from a finite element model created by the NRAO structural engineer. Final repairs are in preparation and will be completed

when confirmed by the analyses. Some minor, non-loadbearing defects were found elsewhere and will be repaired when time permits.

Painting also began in May, and is being done in areas inspected last year.

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 even 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 PTCS activities, GBT Servo support, Spectrometer support, and the Caltech Continuum Backend project.

About 3 FTE's were supplied to the PTCS project. This consisted of sensor construction, installation, maintenance, and calibration work, along with active surface maintenance.

The GBT servo system work for this quarter consisted of repairs to motors, wiring, and tachometers. An elevation motor failed this quarter. The failed motor was taken to the vendor's motor shop and repaired with us in attendance. All the other motors on the system have been inspected and several have been found to have various problems. A revised PM program has been instituted to address these deficiencies.

Much of the spectrometer support rendered this quarter was for the purpose of developing and testing the Spigot cards and associated modes. The spectrometer is in general fairly reliable although it occasionally produces bad data that is usually obvious. We continue to work on an LTA card replacement, with this quarter providing us with a design review of the card. About 2 FTE's are provided to the Spectrometer.

The Digital Group is supplying engineering to assist the Caltech Continuum Backend project. We are designing the analog front end, including the receiver detector preamp, and consulting on the design of the digital sections of the backend, as well as the packaging design. About 1.5 FTE is assigned to this task.

Other items that the Digital Group is involved in are reviving the 45 ft. telescope for use by the Solar Ratio Burst Spectrometer, repairing/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.

This quarter saw activity on the high-frequency receivers. The K-band receiver was in use as the workhorse of the high-frequency season. The Q-band was used for astronomy projects. The Ka-band receiver construction is on-going, but a subset of the receiver was tested on the telescope. The group maintained 8 cooled receivers on the telescope.

The IF system received some attention this quarter as well. 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 300kHz 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. More Microwave group activity is noted under the baseline investigation project and the Ka -band project.

RFI Group activities

Direct Observer Support and Spectrum Monitoring

The group supplied effort to suppress cable TV and power line interference. It also provided support for observers in the form of allocation information, monitoring, and Prime Focus 1 and 2 RFI surveys. The group is also working a possible front end overload problem at the 40 foot.

NRQZ Administration

Ten requests for preliminary evaluation on 16 transmitter sites were completed. 63 regular applications for 212 sites were also completed. ERPd restrictions were requested on 16 sites. NRQZ coordination with DirecWay is underway.

Green Bank Telescope

Community RFI Management

An internal staff memo on electric fence RFI was distributed. A brochure on the same topic, for community distribution, was also developed. We continue to work with the local cable TV supplier to ensure that they maintain a low-leakage system.

An extensive effort to assess the RFI risk associated with the operation of IEEE-STD 802.11b wireless LAN devices in the vicinity of the Observatory was completed and comprehensive coordination criteria were developed and agreed to by the IPG.

Public Relations and Awareness

Several groups were hosted to help enhance understanding and increase cooperation. RFI group members participated in a Richmond Times Dispatch interview for an NRQZ article published in late June. The RFI group members supported the Quiet Skies teacher internship and Pocahontas County High School student mentoring. Wes and Denise attended the change of command ceremony at Sugar Grove.

Instrumentation Improvements

The design for the RFI Monitor gimbal for the GBT was begun. This will allow us to mount RFI antennae at the tip of the GBT feedarm. The SE test set upgrade was completed.

On-Site RFI Management

Filters for the new Science Center compact fluorescent lights were specified. A prototype fixture was installed and evaluated. The RFI group will request funding to complete this effort this fall.

A noisy HVAC system power controller at the GBT actuator room was identified. Additional testing is underway to evaluate the problem.

An abrasive strip was installed adjacent to the RFI gasket on the GBT actuator room door in an effort to better secure the RFI gasket.

Some PC monitors and several other components were tested in the chamber. Flat-panel PC monitors were found to be more harmful than CRT monitors.

Dome screens and filters for the Josler security cameras were identified after extensive testing.

Mechanical Engineering and Central Instrument Shop

This quarter the Mechanical Division completed the installation of the upgraded rotator on the outdoor receiver test range. Design work has progressed on handling equipment which will enable testing and pre-installation checkout of smaller receivers in the Prime Focus Receiver test building.

The Central Instrument Shop completed fabrication of the optics tower for the Penn Array during this quarter. This work included the shop's development of an improved assembly procedure. It required the shop to design and fabricate assembly fixturing. Also in this quarter the shop began increased activity in the fabrication of parts for the GBT MM Converter. An order was completed for 20 five slot bins for EVLA. A request for 8 ALMA LO Frame Assemblies was received in the second quarter and will be completed in the third quarter. Several other smaller requests for parts for ALMA that were completed in quarter 2.

Software and Computing

Software Development

The SDD produced two regular releases of its key product, M&C, with v4.3 on May 19, 2004, and v4.4 which was released on June 30, 2004. Fixes and enhancements were made in many different areas. A new refraction algorithm was enabled within the antenna control system, and several new keywords were added to the antenna FITS file. The beam offsets table was changed to be "beam relative," that is, the offsets of the selected beam always read as zero while the offsets of the other feeds are now reported as relative to the tracked beam. The Antenna Characterization Manager, which supports dynamic corrections for pointing and focus, was greatly improved throughout this period and is now extremely reliable. The process for turning the Active Surface power supplies off was shortened from 5 minutes to 1. Actuator faults are also cleared correctly. The IF Manager was also improved. Previously, LO frequencies were accurate only to the precision of a float. This would produce errors in the kHz range or smaller. Now, LO frequencies are accurate to the precision of a double, which permits data reduction to accuracies better than 1Hz. Several steps were taken to improve antenna trajectories, including the addition of a variable settling phase, reducing the acceleration used for short slews, and optimizing the antenna stopping phase.

There were three new additions to the telescope control system in Q2: the Inclinometer Manager, the Accelerometer Manager, and the Common Millimeter Converter Manager (which will be used with the new Ka-band receiver and Caltech Continuum Backend). The Inclinometer Manager samples inclinometer sensors which were installed as part of the PTCS project. The Accelerometer Managers controls and receives data from three 3-axis accelerometer modules through one or more concentrators (small independent computers whose function is to perform port translation). A health monitor was also developed to detect drift in the measurements from temperature sensors which were recently installed on the telescope.

Several other smaller items were accomplished as well. A GPIB interface was developed for Java Native Interface (JNI) to be used with the Penn Array Receiver control software. Additions were made to spectrometer self-test, and fixes were performed for the spectral processor quick tests. Small changes were also made to the X-band receiver to reflect changes made to the hardware. The reliability of the Archivist, which allows an observer to record selected samplers from any manager in the system as a part of scan data, was examined and several options were identified for improvements. These will be developed and released in Q3. A control library deadlock problem was also resolved which may have been contributing to spurious system-wide failures. Additionally, the SDD participated in discussions related to project planning for the proposed wideband spectrometer.

The real-time Quick Look data display, GBT FITS Monitor (GFM), is now in regular production use for continuum observations. During Q2, many improvements were made in its reliability and handling of fitted data. Beam-switched data is now supported along with corrected Tsys calculations, peak scans for prime focus receivers are supported, and the application now reliably fits all data that has been independently verified as good. With the integration of the array handling package developed at the Space Telescope Science Institute, the plotting speed of the graphical display was greatly improved, particularly for large datasets. Most scans will now plot within one second (this is supported by GFM benchmarking metrics which are available from the GB Data wiki). For those users who do not wish to set custom application preferences, there is now a default preferences file which is used for the initial configuration of GFM. Messaging has also been improved, and failures provide much more detailed explanations. The scan panel now shows which source is being observed, and provides access to GBT data at the sub-scan level as well.

Computing

Video Streaming

The SARA (Society of Amateur Radio Astronomers) conference held at Green Bank this quarter was successfully broadcast over the web as a live windows media video stream. Reports from those members who viewed the webcast were very favorable. This took a fair bit of effort to set up initially but we will in future be able to provide this facility fairly easily. To protect the limited bandwidth available at Green Bank the video stream is transmitted to Charlottesville prior to being broadcast out to internet connected clients.

Summer Students

As is usual, preparation for the summer students has been a large part of the division's work this quarter. The basement room is now fitted out, with a much quieter network switch and semi-permanent cabling which will be retained to reduce the workload in future years. All the new student machines have been installed with the requested operating systems and configured. As well as these machines a few others have been set up dotted around the building for coop and pre-doc students.

Green Bank Telescope

As well as the summer students the division has been providing assistance to the GASP cluster installation team.

Network Improvements

Further work has been done on the network in the equipment room. A great deal of unused and redundant fiber has been removed and some equipment reconfigured for more efficiency and speed. Documentation of the network has seen some improvements as well. We are slowly moving this from white-board based to wiki pages which will be easier to maintain and more accurate. A program for replacement of the aging Alcatel switches is being prepared.

RedHat Successor

With the withdrawal of support by RedHat of RH9.0 at the end of April, the division in conjunction with the CCE project is evaluating possible successors. These include Whitebox which is based on RedHat Enterprise Linux and Fedora which is RedHat's replacement. Some consideration will also be given to using the licensed RedHat Enterprise Linux.

Hardware

The spigot machines as well as Euler have now been racked in the equipment room with a new UPS. Euler is a new high-powered data reduction machine with a large memory, raid discs and is intended for processing large data sets. Use of this machine must be booked through the division web page.

An experimental firewire800 interface has been fitted to spigot2 which allows faster transfer of data to external discs. Use of this interface requires assistance and is not yet generally available.

A new large UPS was fitted to the rack housing earth, wind, fire and gemini. Previously these machines had no UPS. Logs show that since its installation there have been 3 power outages of short duration which previously may have caused a spontaneous reboot.

Software

Classic AIPS has undergone an overhaul and now works on all configured Linux machines. Support for AIPS on Solaris machines has been terminated due to lack of demand and resources to maintain it.

As part of the CCE project new software management system has been deployed to help keep track of, and ease the maintenance of, third party software packages.

Project Reports

Precision Telescope Control System (PTCS)

The GBT is now routinely operating at Q-band (43 GHz), with acceptable performance for both pointing and surface efficiency. This represents a major milestone for both the PTCS project and the GBT as a whole. PTCS work over the second quarter of 2004 has covered a wide range of areas, as described in the following section:

Surface Efficiency/Holography

The first campaign to measure and adjust the surface, was completed in April. Consistent results were obtained at the geostationary satellite elevation (42 degrees) by both the traditional and out-of-focus measurement techniques; both indicated an rms surface error of ~400 microns, dominated by large-scale errors. A number of attempts were made to test the holography results by performing back-to-back efficiency measurements on 3C286 and 3C279, with and without the corrections applied. Unfortunately, absolute efficiency measurements were prevented by the uncertainties in the receiver calibration and the poor weather conditions at the time of the observations. However, in all cases, the peak gain was improved by ~20-30%, the beam FWHM became closer to the theoretical value, and sidelobes were significantly reduced. We are therefore confident that we can use holographic measurements to substantially improve the surface accuracy of the antenna. The problems in determining absolute efficiencies have revealed a number of problems with the calibration of the Q-band receiver. These will be investigated, and improved calibration methods developed over the summer.

Pointing/Focus

We continue to refine the pointing and focus models via the addition of new data, and application of refined techniques. Continuously performing repeated peak/focus measurements on a single bright source for a period of hours has provided additional constraints on the models. Estimates of the model coefficients have been improved by the use of robust and weighted fitting methods to mitigate the effect of outliers (e.g. observations contaminated by RFI) and low S/N datapoints. In late May, we suffered a failure of one temperature sensor (the first apart from two installation failures). Given the rarity of such failures, we have decided to adopt the approach of revising the thermal corrections model to specifically account for a failed sensor as and when necessary. Detailed health monitoring checks to detect such failures have been developed and are now run nightly.

A new pointing catalog is being developed using the NVSS to select appropriate isolated, point sources, but using very accurate (<0.1 arcsec) positions from FIRST, VLA, VLBI and other catalogs. The catalog currently has ~6000 sources defined, and will be released for general use once the final checks on source structure are complete. Significant improvements have also been made to GFM (GBT FITS Monitor), the application which performs the real-time analysis of peak and focus observations. This is

now significantly faster, and more robust in the presence of input problems (corrupt FITS files, poor S/N data, etc).

Instrumentation

Considerable progress has been made in the last three months. Accelerometer and Inclinometer sets are now installed in the receiver cabin, and on one elevation axle. Data acquisition via a standard M&C manager and the archivist is now routine. Additional sets will be installed in the coming quarter. Five additional temperature sensors have been installed on the antenna backup structure, and the sixteen actuators LVDTs which are capable of logging temperature have been reconfigured appropriately. An IR imager has been rented, and together this instrumentation will be used in June and July to prototype our ability to measure thermal gradients in the primary, for use in quantifying large scale surface errors. If successful, these techniques will be used during the next winter, in conjunction with out-of-focus holography, for the next surface improvement campaign. The Quadrant Detector has been recalibrated, to provide significantly improved performance, and will be reinstalled on the antenna at the end of June. Work has started on assessing and improving laser rangefinder performance, with the initial steps being to measure beam divergence and servo stability and repeatability.

Ease of Use Initiative

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 observing, the ability to execute those observations, improved monitor and status information while observations are executed, and an improved real-time display. At the moment, Ease of Use work is focused on providing readiness for Scheduling-Block based operation, including completing Application Programming Interfaces (APIs) for Configuration, Observing and simplified Balancing which will be used by a Scheduling Block Executor.

Analysis

In Q2, the initial draft of a Scheduling Block (SB) Specifications document was written. This covers NRAO observatory-wide concepts in the Project Model and Observing Model and how they relate to the GBT, a requirements outline for an SB-based observing system in Green Bank, the definition for which entities defined by ALMA will be used within GBT SBs, and descriptions for the behavior of the Observation Preparation Subsystem, as well as the execution and archival of SBs. Fourteen GBT Standard Observing Modes were also defined, eight of which have options for multi-IF and cross-correlation use. These were cross-referenced to configuration cases, which describe typical setups for each of the modes. In the upcoming quarter, observing cases (using the new Observing API) and data reduction cases will be generated. This will provide the foundations for more automated observing, including remote observing, and ease the planning and development for pipeline processing for selected GBT observing modes in the future.

Green Bank Telescope

Configuration

The Configuration API is currently accessed using an interactive command line called the "config_tool". During Q2 a wealth of incremental improvements were made, including performance enhancements to make spectrometer observations configure more quickly and more reliably regardless of the state of that device at the onset of a systems setup. Certain spectrometer fault states are now automatically resolved during configuration as well, significantly reducing possibilities for user error. The path selection algorithm for the DCR now routes properly even when multiple optical drivers are out of service. A new configuration mode was added to be able to set up the BCPM for pulsar spigot observations, which are frequent in June and July. Several smaller items (such as altering default settings) were also included.

Once GBT moves to its intended SB-based observing system, the Configuration API will be accessed in shorthand through the ObsProcedure entity of the SB. In Observing API tests already conducted during Q2, predefined configuration cases can be accessed by calling the name of the case from within the observing script (e.g. Configure ("Galactic HI with the Spectrometer")).

Observing and Balancing

Significant work was completed on the Observing API (which will replace the GO glish application). The Observing API provides the underlying observing script functionality which can be accessed in the observer's definition of his or her Scheduling Block. The intent is for the Observing API to be used (a) to create new user-defined scans, and (b) for testing and other experiments by staff astronomers. Visiting observers will be able to edit their Scheduling Blocks directly, or to construct their SBs from within a GUI application (to be developed during Q3), but should not regularly use the Observing API directly to observe as managing and archiving observations is not possible when this route is chosen.

The beta release at the end of Q2 included the following features:

- Ability to run an observing script from a GUI in interactive, debug, and trace modes for testing
- Automated capture of configuration/setup information in the GO FITS file, which captures observer's intent
- The ability to annotate the GO FITS file with additional comments directly from within the observing script
- A prototype of how breakpoints can be handled in the observation for unexpected problems (such as aborts in the middle of observing)

A Scheduling Block contains project metadata and references to sources (within or external to source catalogs); the Observing API focuses solely on the functionality underlying the observing script (which is contained within the ObsProcedure entity common to GBT and ALMA).

In May, commands were added to automate balancing (primarily for use by pulsar observers using the spigot card remotely). A means to maintain IF power levels going into the spectrometer was provided, where power levels in the analog filter rack are monitored and attenuators in the converter rack adjusted approximately every 10 seconds to obtain a balance. This is referred to as "in-scan" balancing. Another script for "simple" balancing was completed, which first balances the IF rack. Then, the resulting RF power samplers are displayed to the user. The spectrometer is then balanced and the resulting duty cycles are displayed to the user. A complete balancing API is required that will be integrated with the Configuration API and Observing API for unified access from within a Scheduling Block, but there is significant investigative work required to make this useful, and so it will be developed as part of a separate, future project.

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. In Q2 2004, work included (a) continued incremental improvements to the new real-time display, GBT FITS Monitor (GFM), (b) additional improvements and the production releases of SDFITS and CLASS binary generators, and (c) proof-of-concept exercises to resolve design issues for a package of IDL modules. To satisfy short-term data reduction needs, IDL modules are being developed to support basic continuum and spectral line observing, based on the work of Tom Bania who has produced a unipops emulation in IDL for his observing. There are no plans at this time to develop improved single-dish imaging; users will be encouraged to use the AIPS++ Imager with IDL as a pre-processor, or to write their own IDL modules as desired.

Accomplishments during Q2 included the second Production Release of the SDFITS generator on May 27, which incorporated improvements to the frequency axis information stored in the file. Now, the derivation of each frequency axis descriptor takes into account the sampler, integration, and phase. This allows SDFITS files to be produced when observing in a greater number of observing modes, such as frequency switched, OTF mapping, and multi-IF observations. A proof-of-concept experiment involving interlacing SDFITS production with the observing process was successful on June 20th; visiting observers who use IDL for all of their data analysis were able to evaluate their incoming data in this package in real time.

Most importantly, this quarter is marked by the completion of GBT Standard Observing Modes on June 25, which will be used to unify the observing and data reduction processes and enable structured testing of all new software applications.

Although some progress was made on proof-of-concept experiments for an institutionalized IDL package, planned work on calibration routines was not possible because the specifications were not available by the end of the quarter. The work originally planned for Q2 2004 has been shifted to Q3, focusing on three areas: calibration, real-time display of spectral line data on an integration-by-

integration basis, and compiling an IDL package for visiting observer use. Enhancements to DISH to apply the newly implemented calibration algorithms are planned for this period as well. A Science Data Model (SDM) committee must also be launched during Q3 to provide a conceptual specification for the data structure to which all export data formats (EDFs) should conform.

Baseline Investigations

Work this quarter was carried on at a low level. Work continues on stabilizing the environmental controls in the equipment room. Isolation amplifiers for the LO2 signals were developed and tested, without any improvement. The power dividers in the Optical Receivers seem to be very sensitive to temperature. Work is underway to understand this effect. Several modifications remain to be completed in the IF system. Once this work is complete, the baseline project will update EDIR 312 from last year with any improvements made, and the project will be closed out.

A new, long-term project will be started in collaboration with CDL to identify new approaches to system design to eliminate the remaining baseline problems. As a precursor to this next phase, we have outfitted a test dewar to facilitate testing of individual components and portions of receivers, and initially installed a LNA and cooled mixer from the Q-band system. Tests of these components with the spectrometer are continuing.

Another initiative now beginning is the resurrection of the "ALMA Test Correlator", a now-surplus correlator similar to one-quarter of the GBT spectrometer. A summer student is adapting the GBT Spectrometer software to this device. Availability of this test device will greatly speed our ability to study spectral stability of receivers and components.

And finally, some data processing and calibration techniques are being studied to improve the system.

Penn Array

In the 2nd quarter of 2004 the optics tube and detector box designs for the Penn Array were finalized and submitted to the Green Bank machine shop, where they were manufactured. Penn cut plastic test lenses and integrated these with most of the optics components into the final cryostat machined at Green Bank in December 2003; the cryostat was cooled down with realistic thermal loads and achieved < 230 mK at the 3He condenser. Cable orders were also completed and most cables are in hand, with the exception of those which are attached to the series array. Goddard completed the set of masks needed to manufacture the detector array, with a mechanical yield of 62 detectors out of 64; GSFC will be working on a second set of masks, and production, over the summer. The filters needed for the Penn Array were completed by Cardiff University and need only to be cut to the proper size. Green Bank wrote the Java Native Interface needed for NASA's Instrument Remote Control software to talk to the GPIB devices which will perform housekeeping and cryogenics control. Simon Dicker presented a talk

about the instrument at a TES bolometer conference in Miami, and Brian Mason spent a week in Philadelphia learning how the cryostat is assembled and how the warm multiplexing electronics functions.

New Receivers / Backends

Tony Readhead's group at Caltech continued to work on the design of the FPGA program for the Caltech Continuum Backend (CCB), and produced a substantial document detailing the design. NRAO continued designing the actual electronics boards which comprise the CCB. The design for one of the two primary boards is complete and ready for layout, and the design for the second (master) board is approaching completion. A project meeting was held in May in Green Bank to review the status of the design. A Chilean graduate student from Readhead's group will spend four months (July-October) in Green Bank working on packaging, integration, and testing, supported by NRAO's Graduate Student Internship program.

Preliminary (engineering) checkout of the 26 - 40 GHz Ka band receiver was conducted in May. Early results are encouraging although several issues have been identified for attention over the summer; astronomical commissioning is scheduled for late fall 2004.

Spectrometer Upgrades and Pulsar Backends

The work on the GBT backends focused on the autocorrelation spectrometer and the GBT Spectrometer Spigot card. Work to upgrade the LTA boards of the autocorrelation spectrometer (ACS), a project which should solve many of the reliability problems still plaguing the system, progressed considerably. The initial re-design of the LTAs is complete, and a design review was held on June 14, where a number of minor improvements were suggested. The final design, including the board layout, will be done by October 1 when the building of the new boards will commence. The only other reliability issue which has not yet been solved is the lag 'drop-outs'. While the hope is that the LTA board replacement will also solve this problem, an in-depth investigation is underway to insure we understand the reasons behind the drop-outs.

Building of the cross-correlation test fixture for the ACS has begun, and the first noise source has been built and successfully tested. The filter banks needed for the test fixture are now being built, and the plan is for the test fixture to be complete by late summer. Once it is complete, the spectrometer and spigot cross-correlation modes can be tested.

Work on the GBT Spectrometer Spigot card focused on two main issues: solving the problems with the variance in the power levels saturating the 2- and 4-bit modes, and increasing the number of modes available to the users. The power level variance issue appears to have been solved, and numerous 4-bit modes are now available to use. Testing has now begun on the 2-bit modes, with the goal being to have all priority 1-3 modes, except those requiring cross-correlation, available for use by early fall. In

addition to the above, we installed the new spigot computer (spigot2) and have begun remote observing (a bit ahead of schedule).

A second fast base-band recorder for pulsar timing work, the GBT Astronomical Signal Processor (GASP), is now being installed at Green Bank. It should be in operation by mid-July, when the first astronomical projects are scheduled to use it. The Caltech-Green Bank-Swinburne Recorder II (CGSR2) de-dispersion machine, also installed in January, is scheduled for its first astronomical projects in July as well.

Finally, as the GBT's other backends (the Spectral Processor, an FFT spectrometer used for both spectral line and pulsar work, and the Berkeley-Caltech Pulsar machine) performed reliably over the last few months, no work took place on either system, bar an effort to integrate them, and the Spigot, into the new configuration API being developed by the software group.

Very Large Array and Very Long Baseline Array

Very Large Array Highlights

Two large VLA proposals were awarded time by an external evaluation committee. One will make a deep study of the COSMOS field being observed by HST and other instruments, while the other will follow up on gamma-ray bursts expected to be found by the Swift satellite after its launch later in 2004.

The azimuth bearing was replaced on VLA antenna 14, bringing to eight the total number of such bearings replaced over the history of the VLA. Several more bearings purchased late in 2003 were received, and will enable the replacement of three more bad bearings in 2004 and 2005.

Work was initiated on an operations plan for the VLA during its multi-year transition to the EVLA over the next five years. Specific milestones for this plan, including a preliminary schedule for some new scientific capabilities, are expected to be developed during the third quarter of 2004

Very Long Baseline Array Highlights

The Large Proposal review process resulted in an award of 336 hours of time for the continuation of the project "Monitoring of Jets in Active Galaxies with VLBA Experiments," or MOJAVE.

A proposal opportunity was announced for a High Sensitivity Array of VLBI antennas, including the VLBA, phased VLA, GBT, Arecibo, and Effelsberg radio telescopes. More than 20 proposals for this array were received at the June 1 proposal deadline.

A decision was made to severely curtail maintenance spending on the operational VLBA tape recording systems, in order to save money that could be spent on purchasing Mark 5 disk-based systems and associated disk media. This enables an acceleration in the plan to implement the Mark 5 system in the VLBA, so that 3 of the 10 VLBA stations should be fully operational by the end of August 2004. Continued expansion of the Mark 5 system will depend on the level of future operating budgets and/or external funding from non-NSF customers.

Very Large Array and Very Long Baseline Array

Joint VLA/VLBA Highlights

The 9th Synthesis Imaging Summer School was held at NRAO and on the campus of New Mexico Tech. This version was the most heavily attended such school held yet, with 148 attendees from more than a dozen countries.

Management and Scientific Services Milestones

Milestones	Original Date	Revised Date	Date Completed
EVLA Phase 2 Proposal Submitted to NSF	02/28/04	04/09/04	04/15/04
Global 3mm VLBI Session	04/21/04		04/21/04
Large Proposal Review Committee Meeting	06/30/04	04/30/04	04/30/04
VLBI High Sensitivity Array Call for Proposals	04/01/04		05/06/04
AIPS++ Stable Release 6	05/15/04		05/15/04
Temporary Office Space Occupied	05/10/03	06/01/04	06/02/04
VLA/VLBA General Proposal Deadline	06/01/04		06/01/04
Synthesis Imaging Summer School	06/30/04	06/22/04	06/22/04
AIPS++ Stable Release 7	07/15/04		
Complete Project-Oriented Sci. Staff Reorganization	05/15/04	07/15/04	
Pie Town 3mm Test After Re-setting Panels	05/31/04	10/31/04	
Complete VLBA Pilot Program for S/C Navigation	01/30/04	08/31/04	
Implement Mark 5 Recorders on Two VLBA Stations	12/31/04	08/31/04	
Initial Version of Proposal Submission Tool	09/01/04		
AIPS++ Stable Release 8	09/15/04		
VLA-Pie Town Link 4th Operational Session Begins	10/01/04		
VLA/VLBA General Proposal Deadline	10/01/04		
Global 3mm VLBI Session	10/13/04		
Implement Mark 5 on Three VLBA Stations + GBT	10/15/04		
VLBI High Sensitivity Array—First Observations	11/01/04		
New Mexico Symposium & Jansky Lecture	11/15/04		
AIPS Frozen Release of 31DEC04, Begin 31DEC05	12/31/04		
VLBA Huygens Probe Tracking Experiment	01/14/05		

Very Large Array and Very Long Baseline Array

Milestones	Original Date	Revised Date	Date Completed
VLA/VLBA General Proposal Deadline	02/01/05		

Computer Infrastructure Milestones

Milestones	Original Date	Revised Date	Date Completed
Install summer student systems	05/15/04		05/20/04
Deploy MRO building network	06/01/04		06/10/04
Upgrade Archive to 14TB	06/01/04		06/25/04
Examine LDAP support	08/31/04		
Examine OS/X support	09/30/04		
Replace all systems >6 years old	09/30/04		
Migration to Windows 2K domain(1)	07/31/04	10/01/04	
Phase 3 AOC Rewire	12/30/04		

Operations Software Support Milestones

Milestones	Original Date	Revised Date	Date Completed
TRACK program modifications for Mark 5	10/30/03	06/30/04	06/30/04
Satellite tracking software mods	02/01/04	07/15/04	
Correlator controller transition plan	02/28/04	07/31/04	
Correlator controller changes to Modcomp	03/30/04	07/31/04	
Correlator controller bug fixes	03/31/03	07/31/04	
Correlator controller integrate line/continuum	06/30/03	07/31/04	
VLA Op. logs on archive web page	01/01/04	08/31/04	
Transcribe VLA observe/system files	11/30/02	08/31/04	
Online VLA recording to DAT	02/01/04	09/01/04	
Translate and copy stored VLA monitor data from 9-track to DAT	03/01/04	10/01/04	

Electronics Milestones

Milestones	Original Date	Revised Date	Date Completed
Pie Town Link (LO/IF)			
Pretest Pie Town Link hardware and software	08/13/04		06/05/04
Mark 5 Operational – VLBA Pie Town	08/20/04		
Complete construction & checkout of spare L6, F4 and Pie Town data sets. Develop a full system checkout procedure	09/30/04		
Mark 5 Operational – AOC playback system	12/15/04		
Lab Services			
Implement ESD procedures in assembly areas	07/30/04		06/18/04
Move the Drafting Department to the second floor	09/15/04		
Receivers (FE)			
Install K-band receivers #29 and #30 in the VLA	09/15/04		
Install C-band prototype #XN-1 in VLA Antenna 13	12/15/04		
Improvements			
Investigate the impact of XMSR and the 2.56 GHz Broadband Internet on VLBA Fort Davis, TX S-band performance	06/15/04		04/25/04
Replace the maser at VLBA Hancock, NH	07/30/04		05/30/04
Repair Maser #3 located at AOC	09/15/04		
Upgrade the ACU power supply & backplane at VLBA Pie Town, NM	09/15/04		
Install digital tachometer system at Fort Davis, TX	09/30/04		
Investigate the impact of Bandpass Filters install at S band on RDV observations. VLBA Owens Valley	09/30/04		
Design and fabrication of a compact, ultra-wide band antenna for use in the VLA shielded Chamber.	11/05/04		

Engineering Services Milestones

Milestones	Original Date	Revised Date	Date Completed
Complete DnC array reconfiguration	05/28/04		05/19/04
Complete D array reconfiguration	06/18/04		06/15/04
Complete A array reconfiguration	09/17/04		
Mechanical Group			
Receive new azimuth bearings	04/30/04		04/30/04
Pie Town maintenance visit	04/05/04		05/14/04
Replace Ant #14 AZ bearing	05/30/04		05/27/04
Ft. Davis maintenance visit	06/10/04		06/18/04
Pie Town rail repair	06/18/04		06/18/04
Resurface Pie Town subreflector	06/30/04	07/27/04	
VLBA second drive wheel construction	06/30/04	07/31/04	
Brewster maintenance visit	08/09/04		
Owens Valley maintenance visit	10/04/04		
Adjust panels Pie Town	05/15/04	09/30/04	
Mauna Kea azimuth rail repair	06/16/03	09/30/04	
Electrical Group			
VLA anemometer upgrade	04/01/04		04/01/04
Site & Wye Group			
Complete track repairs between BN6-AN5	12/31/02	07/31/04	
ES Engineering Group			
Water tank repair	09/30/04		06/09/04

Track repairs were delayed due to equipment failures.

Interferometry Software Division

AIPS

Key Developments

1. Updated the CookBook and created fully cross-linked html and pdf representations. This has been made possible in part by restoring the AIPS script that converts help files to html and then improving its capabilities.

2. CLCAL, the task that converts solution tables into the full calibration table, was given a more powerful method to determine calibrations applying sources only to themselves. The calibration table correction task CLCOR was given new options to shift the source mean rather than apparent coordinate and to apply total atmospheric delay models.

3. Source models for four primary flux and/or polarization calibrators at the three highest VLA frequencies are now included with the AIPS distribution. The new task CALRD reads them into a user's data area and the new verb CALDIR shows what is available. Work to extend the selection of models has begun.

4. A new task called ATMCA was written to use nearly simultaneous observations of multiple calibrators to determine a more precise calibration for the target source. While less efficient in terms of time on the target source, this method will improve those observations that are limited by the atmosphere rather than simple signal-to-noise ratio.

5. The automatic update scripts (the "midnight job") were improved to perform several chores previously assigned to local AIPS managers to do by hand. This includes updating the vocabulary of known verbs and adverbs, rebuilding the AIPS TV, and rebuilding certain fundamental control scripts.

6. A powerful verb (SYSTEM) was added to AIPS to allow users to run non-AIPS commands directly on their computers while remaining inside AIPS. Another new verb (RANDOM) to generate random numbers was written and changes were made in the print tasks to make it easier to use AIPS print files in other programs.

7. A new task called FLAGR was created to introduce various methods of editing data automatically. It is still in the preliminary testing stages with more algorithms still to be written.

8. In the first half of 2004, 141 sites downloaded the 31DEC03 (frozen) version of AIPS and 466 downloaded the 31DEC04 (development) version. A total of 471 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.

Goals for the Third Quarter 2004

1. Continue user support and bug fixes as the major portion of AIPS effort.

2. Provide support for pipeline data reduction, especially new automatic editing algorithms.

3. Add weight-based flagging to be able to use flag tables.

4. Test and implement binary distributions using the IBM Fortran compiler for Mac OS/X computers.

5. Improve atmospheric opacity modeling in VLBI calibration.

6. Work on solving positional errors in VLBA observations of satellites, beginning with correcting for gravitational bending in the Solar system rather than from infinity.

7. Begin investigations of new/improved imaging algorithms, including those dealing with spectral index and multiple pointings.

8. Begin to produce more source models to include with AIPS distributions.

AIPS++

The key activity for this quarter was the preparation for ALMA Critical Design Review 2 which evaluates the progress made in satisfying the ALMA post-processing needs, culminating in the release of stable snapshot SS7. Important deliverables for this review are continuing improvements in performance, steady development/verification of ALMA priority 1 requirements, and a design/roadmap for the code base framework migration. The main performance improvements this quarter were in the basic calibration facilities where improvements of factors of 2-5 were made under different test cases; changes in the I/O methods used for the calibration tables provided the bulk of the improvements. Additions/improvements in functionality as needed for ALMA reduction were made in the areas of calibration, imaging, image analysis, and data editing. Based on an analysis of the offline framework requirements, a decision was made to adopt the ACS framework as the new data reduction framework for early ALMA science and a list of modifications to ACS/AIPS++ generated in support of this.

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

Key Developments

- SS5 release delivered; SS5.5 release delivered (patch)
- SS6 release delivered
- SS7 activity
- *http://projectoffice.aips2.nrao.edu/ss5.html*
  http://projectoffice.aips2.nrao.edu/ss6.html
  http://almasw.hq.eso.org/almasw/bin/view/OFFLINE/CurrentActivity

Highlights:

- Performance improvements to the calibration and imaging routines
- (See ALMA benchmark page: *http://shiraz.drao.nrc.ca:8080/AlmaDRPBenchmarks/*)
- Visualization slice and distance tool
- Visualization enhanced selection and editing extensions
- Imager history recorded (general history classes written)
- Image analysis two-point correlation function (structure function) added
- Image analysis rebin function added

- Visualization slice function added
- Benchmark 3 (VLA spectral line dataset) added to ALMA suite
- Added new autoflag method (setnewtimemed - median in time filter computed per-channel, per-baseline
- Simulator sampler component design document
- Simple transfer of calibration solutions between spectral windows

- AEDF V2 completed. Submitted for formal ALMA review ALMA-70.00.00.00-004-E-SPE
- ACS/AIPS++ framework report document submitted
- Data Capture Design finalized - critical elements of the data flow worked out

- *Framework:*
  ACS/AIPS++ framework report document submitted
  Prototype pipeline code review outline of code base imperatives for organization. Document submitted
  Decision: Offline adoption of ACS for framework.

- Subsystem documents submitted for ALMA CDR2
  Offline Subsystem Plan -- COMP-70.65.00.00.002-I-PLA
  Offline Subsystem Design -- COMP-70.65.00.00.003-D-DSN
  SSG Development Plan -- COMP-70.65.00.00-005-D-PLA
  ALMA Data Capture Process -- COMP-70.50.00.00-001-C-DSN
- Presentations and tutorials for high frequency reduction (mm data from PdBI) given at 9th Synthesis Imaging Summer School
- MOU between computing groups at NRAO/ATNF/ASTRON.

3rd Quarter Goals

1. Preparation for ALMA TST2 which focuses on reduction of mosaiced data. See *http://projectoffice.aips2.nrao.edu/almatst2.html*

2. Prototype for DataCapture component: write subset of AEDF format to the ALMA archive.

3. Simulator write of AEDF to disk. Preparation for data reduction filler development.

4. SS8 development cycle
   - further calibration performance enhancements
   - added new autoflag method (setdata - to restrict flagging use).
   - data selection design document and initial implementation
   - AIPS++ library re-organization

- Initial implementation of ATM library for atmospheric calibration
- Migration to CFITSIO classes (remove existing custom classes – enable FITS files larger than 2.1 GB)
- Re-implementation of code base documentation (doxygen)
- Addition of namespace to code base to avoid name conflicts
- Calibration bandpass interpolation
- Single dish imaging improvements (de-striping algorithms)

Archive

The NRAO Data Archive has been operational for 8 months and allows everyone on-line access to all VLA data and some VLBA data (*http://archive.nrao.edu/archive*). Thus far over 350 users from 175 institutions have downloaded over 8000 telescope data files. The download data rate is about 100 Gbytes per month. Data files over one year old are in the public domain (see URL below for details) and accounted for 3/4 of the file downloads. The data files reside on a hard disk array and provide the archive users with fast access and downloads via FTP.

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 intend to begin archiving raw GBT data and making it available within the third quarter of 2004.

Proposal Tool

Successful negotiations between the ISD proposal tool team and its UK-based ALMA counterpart resulted in the adoption of common architectural principles and implementation. Based on this agreement, earlier formulated requirements, and Strategy and Architecture documents, a project plan was developed. The first major milestone is to have a proposal tool for the GBT the October 1 proposal deadline. Support for other NRAO instruments will follow. All NRAO instruments and projects are involved in the effort, to ensure that the tool does not become too focused on one instrument.

The first release of the tool (version 0.7) took place June 1 as planned, and has been tested extensively by a small core group of testers. Based on its feedback, version 0.8 was released Jun 30, and will undergo testing by the same group. It is our intention to expand the group of testers for version 0.9, to be released August 1.

Central Development Laboratory

Central Development Laboratory 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 work has demonstrated performance meeting specifications. The ALMA local oscillator chains are meeting the requirements for phase noise, phase drift, sideband noise, and power output for all bands. Design of a new 385-500 MHz SIS mixer is making good progress, and HEB mixer investigations for 600-720 GHz are close to the testing phase. The ALMA correlator is making 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 is 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	
Design of EVLA X-band feed horn	12-31-03	07-30-04	
Testing of EVLA Ka-band feed horn	12-31-03	06-30-04	04-30-04
Design of EVLA Ku-band feed	09-30-04		
ALMA Correlator:			
Complete VLBA data recording project	12-31-02	12-31-04	
Support system testing at the AOC as far as the correlator is concerned	03-31-04	ongoing	
Begin testing of assembled circuit cards for the first	06-30-04		05-17-04

Milestone	Original Date	Revised Date	Date Completed
correlator quadrant			
Complete all correlator lab construction work	06-30-04		06-18-04
Place orders for all station and correlator bins	06-30-04		06-15-04
Place order for signal cables	06-30-04		05-31-04
Start testing of prototype data interface card	06-30-04		06-18-04
Place order for 6U power card assembly	06-30-04		04-30-04
Continue to receive and test production circuit cards	09-30-04	ongoing	
Receive first production bins and motherboards	09-30-04		
Start assembling the first correlator quadrant	09-30-04		
Release station/filter card test fixture documentation	09-30-04		
ALMA Frequency Multipliers:			
Complete Band 6 frequency tripler evaluation set with actual driver amplifiers (in process)	12-15-03	09-30-04	
Complete Band 7 frequency tripler evaluation set with actual driver amplifiers (in process)	12-15-03	09-30-04	
Band 6:			
Fabrication run (2 wafers, 50 devices each)	05-01-04		05-01-04
Verify sample devices in existing frequency tripler blocks	06-30-04		06-18-04
Delivery of production waveguide blocks from machine shop	07-01-04	07-15-04	
First batch of 25 units delivered to NRAO (Subsequently, 25 units each month until all of the 139 units are delivered)	07-31-04		
Band 7:			
Finalize the layout and fabricate the mask-set	04-30-04		04-30-04
Fabrication run (2 wafers, 50 devices each	05-31-04	07-15-04	
Delivery of production waveguide blocks from machine shop	07-01-04	07-15-04	
First batch of 25 units delivered to NRAO (Subsequently, 25 units each month until all of the 139 units are delivered)	07-31-04		

Amplifier Design and Development

Work continued on the development of amplifiers using devices from JPL/TRW Cryo-3 wafers. The electrical and mechanical design of a 1-2 GHz low-noise amplifier with a high 1 dB gain compression point was completed. The amplifier bodies were manufactured, and a prototype amplifier is currently undergoing assembly. Additional testing of Cryo-3 devices in the "old style" L-band amplifier

continued. A low-noise L-band balanced amplifier, developed in the previous quarter, has been manufactured and tested.

A substantial effort has been put into the matter of securing access to HEMT's with good cryogenic performance. An agreement between NRAO and JPL allowing for unlimited access to Cryo-3 TRW/JPL devices is being finalized. Also, samples of devices from British Aerospace Systems have been received and will undergo evaluation.

Work continued on the final designs of a 2-4 GHz amplifier, a new version of the 40-50 GHz amplifier, and a new version of the 26.5-40 GHz amplifier.

Support for the Caltech CBI instrument continued. Three 26-36 GHz amplifiers were modified with Cryo-3 devices and returned to Caltech.

A model of a five-stage amplifier, developed using Cryo-3 2080 devices, and troubleshooting assistance were provided to Jodrell Bank in continued support for the Planck LFI Q-band radiometer.

Amplifier Production

Amplifier production and development activities accelerated during the second quarter as the group's outfitting of the NTC was essentially completed. New amplifier production totaled 10 units: six 8-18 GHz, two K-band, and two Q-band amplifiers. Other tasks included six bias card and connector assemblies, several bond wire repairs to older amplifiers, and miscellaneous lab equipment maintenance.

Other Projects

The new chemistry lab has been increasingly busy meeting production needs of both the amplifier group and ALMA. Weekly production value has often been in the range of $3,000 to $5,000, based on estimates from outside plating vendors for similar work. One new process was added, allowing for the electroless nickel plating of aluminum and ferrous components. The nickel plating then allows for gold plating of large amplifier bodies used in the ALMA LO system. The cost savings is nearly $500 per body, while the new process implementation cost less than half of that amount.

Superconducting Millimeter-Wave Mixer Development

ALMA Receiver Development

Band 6 cartridge: In last quarter's report, we showed that one polarization channel of the prototype cartridge had poor image rejection at some frequencies. Subsequent tests have shown that the poor image rejection is associated with one arm of the OMT which apparently has an elevated VSWR. Replacing the OMT with a similar one did not change the result, suggesting that the problem was not due

to a single delinquent OMT. Analysis of the interaction between the mixer-preamp and the OMT indicates that the image rejection can be sensitive to source match under certain conditions. A relatively simple modification to the mixer-preamp has been shown to reduce the sensitivity to input mismatch. Modified mixer-preamps will be measured in the cartridge shortly. At the same time, a test set is being prepared to measure the VSWR of the OMT at 4 K (to date, OMT measurements have been possible only at room temperature).

Technical description documents required by ALMA were begun during the quarter and are 85% complete for the mixer test set, cartridge test set, and sources test system.

PDR: The preliminary design review for the Band 6 cartridge was held during this quarter. A significant finding of the Band 6 PDR review panel was the need for additional rigidity for the Band 6 optical system. An independent mechanical engineer from NRAO reviewed the mechanical design and verified that the planned alignment pins would be sufficient to satisfy the tolerance requirements of the cartridge's optical components. A memo was written providing project details for producing the first Band 6 cartridge.

Local oscillator and sideband source: Completed during the quarter were the computer-controlled sideband sources for the mixer and cartridge test sets, along with the computer-controlled LO for the mixer test set. These sources are now operating in both test sets and provide a significant reduction in test time.

Integration of the production local oscillator into the Band 6 cartridge was also completed during the quarter.

Preamplifier production: JPL and NRAO reached an agreement in principle for procuring InP transistors from JPL. NRAO will join the Cryogenic HEMT Optimization Program (CHOP) operated by JPL and TRW. A contract for the construction of an additional 24 preamplifiers was awarded to Advanced Control Components, Inc., and a pre-production review has already been held at their facility.

Cartridge test system: The first "production" LO system was installed on the prototype cartridge, and a similar sideband source on the cartridge test set. The cartridge was tested with both mixers and an OMT. The only remaining functions to be automated are adjustments of the LO and sideband source power levels.

Software development: Software development during the quarter includes calculation and storage of noise temperatures along with sideband ratio data. This has significantly reduced the testing time for both the mixer and cartridge test systems.

Central Development Laboratory

Non-ALMA Millimeter-Wave Development

385-500 GHz SIS mixer: Design of most of the mixer circuit elements has been completed, including the suspended microstrip-to-CPW transition, CLCPW, microstrip, the pair of microstrip short-circuit stubs and RF choke for the 7 micron SoI (Silicon on Insulator) substrate circuit. The final mixer circuit optimization will be carried out in the coming weeks. This is a joint R&D project between NRAO and UVA, and is supported mainly by an NSF grant to UVA.

Patent application: A draft of the fourth "Response to the Office Action" for our patent application *Millimeter- and Submillimeter-Wave Noise Generators* was prepared and sent to the patent lawyer for review. This document will be submitted yet again to the Patent and Trade Office by our patent lawyer.

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 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. With the help of an NSF REU student, a cryostat is being outfitted for 600-700 GHz receiver noise measurements. Figure 1 shows the HEB mixer block mounted to a bracket with an off-axis parabolic mirror. The REU student is also developing the measurement software in LabView to quickly measure the mixer over a range of LO frequencies using the ALMA Band 9 LO. A diffusion-cooled HEB mixer is being assembled for comparison in the same receiver.

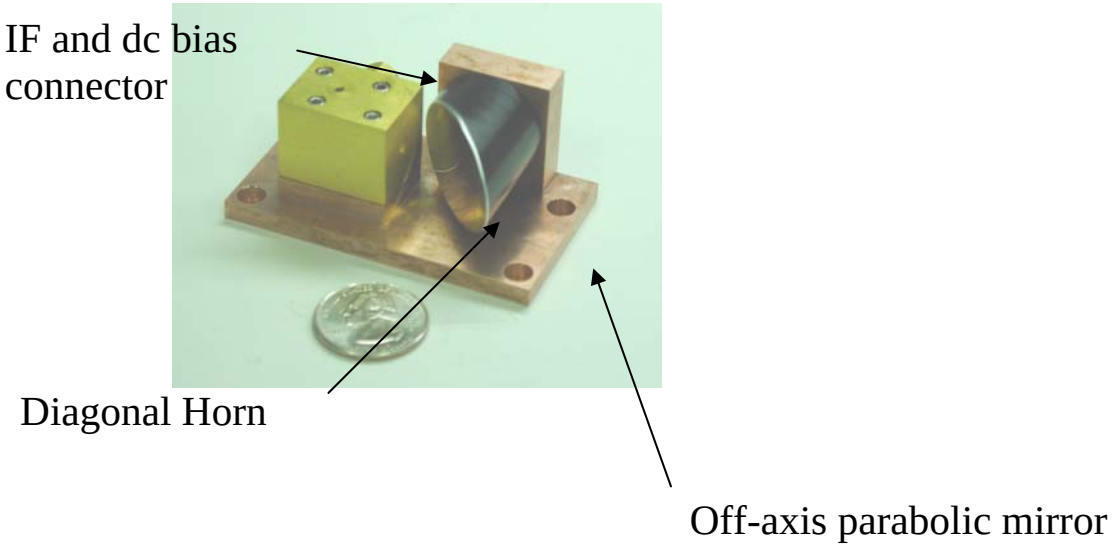


Figure 1. 600-700 GHz HEB mixer block on bracket with off-axis parabolic mirror.

Central Development Laboratory

Electromagnetic Support

EVLA

The broad bandwidths (2:1) on the EVLA receivers below 8 GHz require each band to be split into two waveguide bands while performing measurements. The C-band feed (4-8 GHz) requires two rectangular waveguides (1.872″x0.872″ and 1.372″x0.622″) to cover the 4 to 5.8 GHz and 5.8 to 8.2 GHz ranges, respectively. A circular-to-rectangular stepped transition for the latter band was already designed. A transition for the 4 to 5.8 GHz band was designed and fabricated this quarter. It is expected to have return loss better than -25 dB in the given band.

The inside diameters of two of the vanes in the C-band prototype feed were found to be outside the specified tolerance. A simulation was carried out which indicated that these vanes had insignificant effect on the feed performance.

A prototype of the Ka-band (26-40 GHz) feed was fabricated and measured. Far-field patterns of the feed were measured in the Green Bank anechoic chamber. 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 -28 dB level. Return loss of the feed is better than -32 dB.

VLBA

A preliminary design of a Ka-band feed (26-40 GHz) was completed. This feed will illuminate the subreflector with a -13 dB edge taper.

A preliminary design of the optics for the X- and Ka-band dual frequency operation was completed. A dichroic reflector on top of the X-band feed will reflect the Ka-band signal while allowing the X-band signal to pass through with minimum loss. The Ka-band signal is reflected off an ellipsoidal reflector into the Ka-band feed. The dichroic optics will be removed from the propagation path except when simultaneous dual-band observations are required.

Spectrometers/Correlators

ALMA Correlator

Outfitting of the correlator laboratory was completed during this quarter. This work included the installation of a computer floor, gaseous fire suppression, and an air conditioning system.

Prototype station and correlator bins were received and, after minor modifications, a purchase order was released for all bins required for the system build.

An RFQ for the system cables was released.

First production units of the 6U power card were received and tested successfully.

A prototype of the data interface card was assembled and testing started.

About 250 assembled production circuit cards of various types were received, and all but about 10 have been successfully tested.

Three station/filter card test fixtures were completed and tested. One unit was delivered to Europe.

No work was done on the VLBA data translation project.

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) has been awarded the contract to supply the frequency triplers to meet the full ALMA first LO requirement (all 64 antennae, plus 10% spare units). The progress has been close to the mutually-agreed schedule so far. (See ALMA EDM document number FEND-40.10.00.00-027-A-MIN for details.) The first set of frequency multipliers are expected to be delivered by the end of July 2004.

Two more Band 7 pre-production frequency triplers were ordered and received from VDI in this quarter to satisfy laboratory requirement and/or for integration into the first receiver cartridges. These were evaluated both at room temperature and at 77 K and are ready to be delivered to the project. The test reports are available as ALMA EDM document number FEND-40.10.00.00-032-A-REP.

Band 9: VDI was awarded a contract for demonstration of an improved version of the existing quintupler design that would meet the output power specification with a drive level of 20 mW and supply NRAO/NTC with three units based on this improved design. The contract calls for reoptimization of the existing design based on the earlier results and/or design and fabrication of the quintuplers on InGaAs (which has a smaller barrier height than GaAs) to reduce the input drive power requirement. A wafer run for the first of the two approaches failed to produce usable devices due to fabrication-related issues that are yet to be fully understood. Consequently, the contract 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.

A cascade of frequency doubler followed by a frequency tripler driven by a Band 7 LO driver was evaluated at NRAO/NTC in this quarter and yielded encouraging results. Details of this experiment are available as ALMA EDM document number FEND-40-10.00.00-027-A-REP.

Phase-Noise Test Station for Evaluation of ALMA First LO Driver Assemblies

Also during this quarter, the phase noise test station was used to evaluate two Band 6 LO driver assemblies and one each of the Band 3 and Band 7 LO driver assemblies. All were found to meet or exceed the required specifications; the test results for the Band 6 and Band 7 assemblies are available as ALMA EDM document numbers FEND-40.10.00.00-022-B-REP and FEND-40.10.00.00-029-A-REP, respectively. The results for the Band 3 driver assembly are still being compiled.

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 6 LO driver was delivered to the Band 6 cartridge group and has been successfully integrated with the first Band 6 cartridge (see Figure 2). The SIS mixers were able to be optimally biased across the entire specified frequency range by varying only the bias voltage of the power amplifier. Sideband noise was measured to be better than the same cartridge pumped by a Gunn local oscillator. The local oscillator driver control software was finished, including the capability to phase-lock automatically to a millimeter-wave reference. The Band 6 LO driver is fully ALMA compliant.

Figure 2. Pre-production Band 6 local oscillator driver integrated with Band 6 cartridge.

The first pre-production Band 3 LO driver has been completely qualified and is fully ALMA compliant. It is ready for delivery to HIA for integration with the Band 3 cartridge.

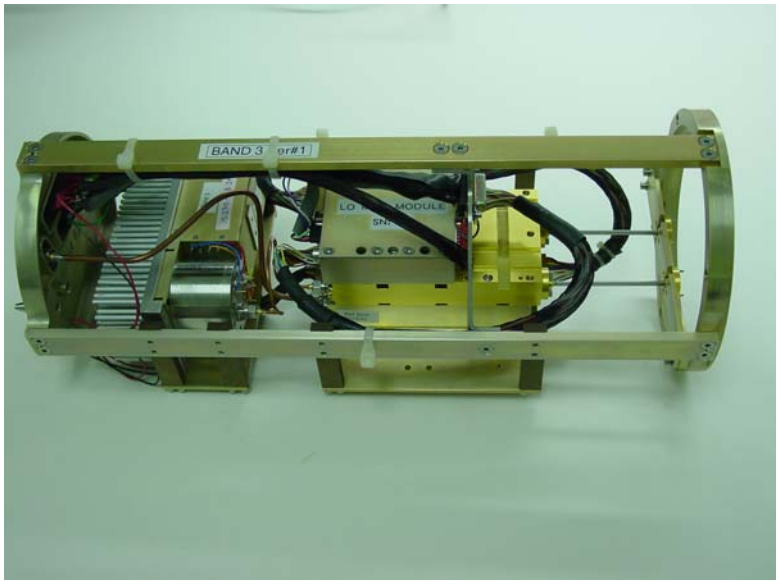


Figure 3. Pre-production Band 3 local oscillator driver.

The first pre-production Band 7 LO driver is compliant except that it does not phase-lock to a millimeter-wave reference over the upper half of the specified frequency range. A solution has been identified and will be implemented in the next two weeks.

The revised Band 9 local oscillator driver uses the same YIG oscillator and active multiplier chain (AMC) as the Band 7 LO driver. A power-combined amplifier, shown in Figure 4, was designed and built using the Band 7 MMIC power amplifier. For each of two channels, two MMIC power amplifiers are combined using a waveguide branchline coupler. The output power is greater than 50 mW over the 102-118 GHz band of interest. This amplifier, driving a cooled doubler-tripler cascade from VDI, resulted in output power greater than 50 μW over the entire 612-708 GHz Band 9 LO frequency range. VDI is under contract to deliver in the next quarter an integrated sextupler with the same interfaces and footprint as the original quintupler design.

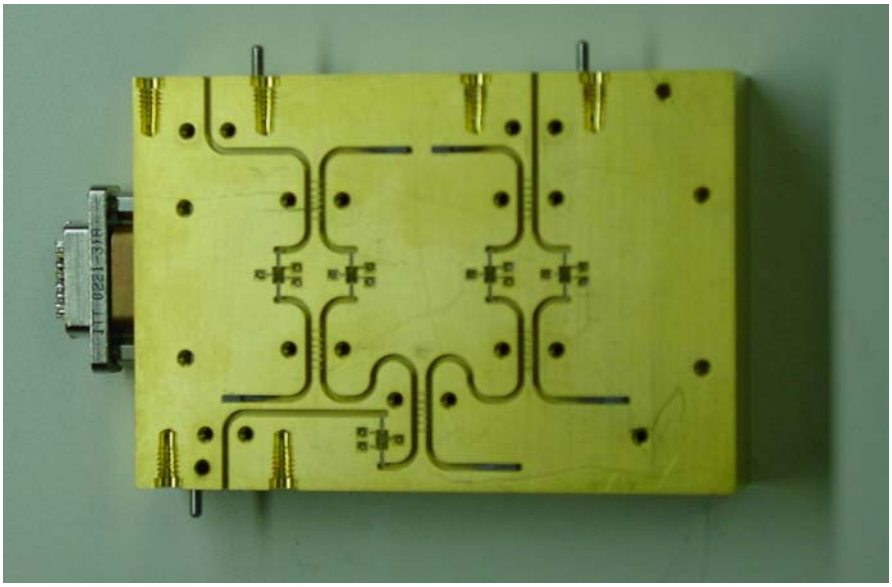


Figure 4. Bottom half of dual channel, power-combined power amplifier for Band 9 local oscillator driver.

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 10-3000 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.

Phase I of the GB/SRBS continues to monitor solar activity on a daily basis with excellent reliability. This system consists of a single polarization inverted-vee style antenna, a high dynamic range low-noise amplifier, and a specially developed sweep frequency spectrometer covering the 20-70 MHz band. The frequency and temporal resolutions are 30 kHz and 1 sec, respectively. Numerous examples of Type-III bursts, three rare Type-II bursts, and a solar "storm" have been recorded. Figure 5 shows a spectrogram displaying 90 minutes of contiguous data taken on April 6, 2004. Flare precursor activity, a B8-class event, and a long duration M-class flare are clearly visible.

The new dedicated server for GB/SRBS is now on-line from Charlottesville. Unprocessed data and data products from GB/SRBS are currently being archived there. An approach to real-time data access was devised and will be implemented next quarter. A higher-speed data acquisition board allowing up to 30 MHz of instantaneous bandwidth has been purchased for evaluation. A REU student intern has begun early prototyping work on the new digital spectrometer for the Phase III upgrade. A sweep-type spectrometer covering 300-850 MHz for use with the GB/SRBS-H, Phase II upgrade was delivered in April from our collaborators at the Institute of Astronomy, ETH Zurich. Two engineers from the Institute visited the NRAO NTC for two weeks to help with the technology transfer.

A dual-polarized version of the 20-350 MHz high dynamic range, low-noise amplifier was designed and is currently under construction. A prototype antenna (dual-polarization, trapezoidal element, log-periodic design in the form of a pyramid) was fabricated and its impedance measured as a function of frequency. The measured performance is in good agreement with the simulations. Power pattern measurements will be performed next quarter. The prototype itself will serve as the feed for the 45-foot (GB/SRBS-H) telescope, and a scaled version will be used as the antenna for GB/SRBS-M. Upgrade of the motor drive control units for the 45-foot radio telescope in Green Bank continues.

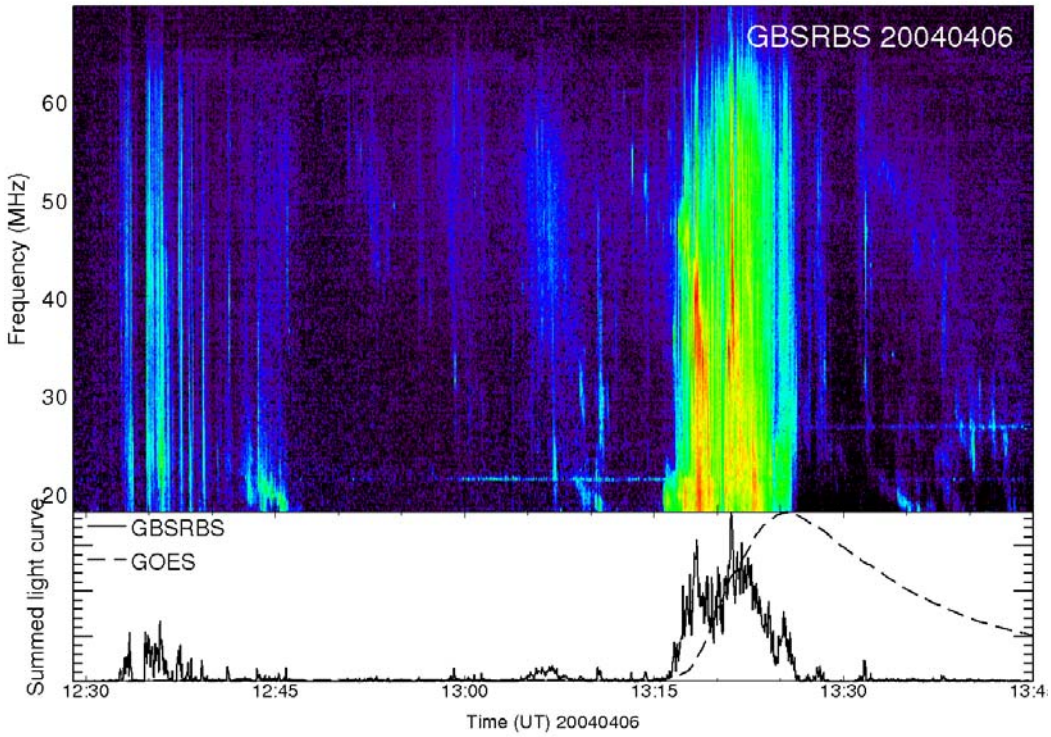


Figure 5. Spectrogram displaying 90 minutes of contiguous data taken on April 6, 2004.

Computing and Information Services

Computing and Information Services Highlights

As a result of focused attention on security, the NRAO continues to be almost completely spared from major virus outbreaks. All sites are now cautious about verifying operating-system patches and anti-virus protection on non-NRAO systems such as visitors' laptops, and the automated patching processes established by the Common Computing Environment (CCE) group for both Windows and Linux are functioning well.

The CCE group has as its goal to ensure that all sites provide a standard configuration of operating systems, network services, applications software availability, and user interfaces. There has been significant progress towards these goals in the last few months.

The deployment of the network and telephony infrastructure in the NRAO Technical Center in Charlottesville has been started.

Overview

This quarter has been a difficult one. First, Jeff Uphoff, who filled the role of communications engineer, decided to leave us to pursue other opportunities. Secondly, Ruth Milner decided to leave NRAO. Ruth's contribution to all aspects of NRAO-wide computing issues for the last fifteen years has been extremely productive. Her absence creates a huge hole in the organization. The loss of these two key persons has resulted in some delays and the need to slow the deployment of new capabilities.

To examine the role of CIS with the new staffing and budgets, there was a complete review of all CIS operations. The review report will be released next quarter.

Central Computing Services

Milestone	Original Deadline	Revised Deadline	Date Completed
CCE: Linux add-on package management deployed	04/30/03	05/31/04	05/31/04
CCE: end AD domain full testing	09/15/03	06/04/04	06/04/04
CCE: complete software audit of Windows computers	05/31/04	06/22/04	06/22/04
CCE: All new Windows accounts in both old and new (AD) domains	05/31/04	06/23/04	06/23/04

Computing and Information Services

Milestone	Original Deadline	Revised Deadline	Date Completed
CCE: begin AD production client migration	09/30/03	06/23/04	06/23/04
Update Computing Security Policy	02/05/01	08/31/04	
Personal firewall on all Linux systems	03/31/04	09/30/04	
Personal firewall on all Windows systems	05/31/04	09/30/04	
CCE: Determine future Linux plans	06/30/04	09/30/04	
CCE: end AD production client migration	12/31/04		

Security

This quarter saw the departure of the former NRAO Computer Security Manager, Ruth Milner, and the appointment of Pat Murphy as her successor. The Computer Security Committee (CSC) members wish to express their sincere appreciation of Ruth's work since the inception of the Committee, including the adoption and implementation of NRAO's Computer Security Policy. Her participation in this forum will be sorely missed.

The composition of the CSC has been modified due to personnel movements and other factors. There is now a significant presence of Windows system administrators on the committee for the first time. In addition, a liaison for business computing (MIS) has been appointed. It is hoped this more diverse group will help to enhance security throughout the Observatory.

The continued barrage of computer viruses and similar attacks from the Internet is still being almost totally prevented from any impact on NRAO Computing by a skillfully managed combination of Internet router filter rules, robust systems to ensure timely deployment of system patches, and avoidance of other vectors for network intrusion. However, the nature of the threats from the Internet is changing, and a concerted effort will need to be made in coming quarters to protect against newer threats, including "ad-ware", "spyware", "phishing", and "malware". The CSC has already started discussion on how best to achieve this required protection. In addition, the committee is focusing on how best to educate the NRAO staff on the new threats.

A draft policy to address security and use of wireless computer networks at the NRAO has been circulated, and it is hoped that a final version can be produced and approved in the coming quarter. This policy will not permit use of any radio-frequency based networking devices at any active NRAO telescope or receiver development facility. It will also require the use of appropriate encryption technology for wireless connections, and encrypted authentication to access NRAO internal resources via a wireless network.

One of the final steps to fully implement the Computer Security Policy is to enforce encrypted authentication to NRAO servers for mail reading from outside the NRAO network. Many of the staff are

already using SSL-based or secure Virtual Private Network connections to read NRAO mail from the Internet already, so this step is not anticipated to cause any disruption. Also, in an effort to blunt the effectiveness of any virus infestation within the NRAO's networks, we are altering our router filters to permit outgoing mail only from the NRAO's four main mail servers. As most viruses that propagate via e-mail use their own built-in mail transfer agents, this step will effectively preclude such virus-infested machines from causing damage to third parties outside the NRAO. Once this step is taken, the committee will discuss how best to adopt the Sender Permission Framework (SPF) technology currently being advanced by major Internet Service Providers such as AOL, Yahoo, and Microsoft. Once adopted, SPF has the potential to cut down on the amount of virus and spam mail for the NRAO and the rest of the online community.

There was one security incident during the last quarter: a Windows computer in the Green Bank Science Center became infected with a large number of "spyware" and "ad-ware" programs. These programs are installed by stealth, typically by a user browsing web pages on compromised servers. The ad-ware programs then always run even when the machine is rebooted, and can cover the screen repeatedly with unwanted advertising. Spyware programs send information on the computer and its settings to unknown third parties. When discovered, the machine was immediately removed from the local network, and the remaining machines on that network checked for viral infections; none were found. This intrusion demonstrates the need for a two-pronged approach to mitigate against such threats: tools to remove ad-ware and spyware programs that are systematically deployed on every vulnerable machine, and user education to browse more safely, avoiding questionable web sites, and routinely to use more securable browsers such as Mozilla or Netscape that are less vulnerable to such attacks.

Finally, it was noted at the end of the quarter that the routine weekly Unix/wiki password complexity checks have shown the lowest number of vulnerable passwords since the program's inception.

Common Computing Environment (CCE)

This quarter marks the end of the accelerated phase of the Common Computing Environment, and the start of a transition to the operational phase. As mentioned in the previous quarterly report, all CCE targets were substantially completed before the CCE Project Review Meeting held in Green Bank during March 2004. It also marks the departure of Ruth Milner as CCE project manager; this function will now be split, with Pat Murphy and Kevin Long as project managers for the Unix and Windows sub-groups, respectively.

Computing and Information Services

The separate effort to deploy directory services, undertaken as part of Central Computing Services under the title "Information Infrastructure" is being merged into the mainstream operational CCE project. As the directory has been successfully deployed, and future targets therefore involve wider cross-site system administrator involvement, this merging has proven necessary.

The Unix third-party software management tool is now in place at all four sites and is in active use. It has already proven useful in reducing the time and effort required to deploy software at two or more sites. The decision on what path to pursue for future Linux installations has not yet been finalized, pending additional consultation with other NRAO divisions, and our collaborators in ALMA at ESO. The testing of alternative Linux distributions has continued and provided useful data points for this evaluation.

Although the completion date for deploying the personal firewall on Linux systems has been pushed back to the end of next quarter, the most critical part of this target is done: NRAO Linux laptops are now routinely configured with the firewall (IPTables) active.

Given the operational status of the Lightweight Directory Access Protocol (LDAP) server currently holding the online NRAO phone book, it was decided to set up a separate test server to investigate expansion of such a facility to incorporate authentication. Configuration of this test-bed is now under way, and testing is anticipated to finish in the coming quarter. We hope to be in a position to merge the test-bed authentication server with the phonebook server by the end of the quarter.

Before Ruth's departure, one of the jobs at hand was to get a complete inventory of the Windows systems, both hardware and software. While the completion of this milestone slipped a few weeks, it task was completed successfully in late June.

The CCE Project Review Meeting in Green Bank defined some important goals that the Windows administrators have made excellent progress in achieving. The first of these goals, application software availability, has gone very well. Windows administrators can now remotely install and update applications through use of Group Policy Objects. Using application publishing allows the Windows administrators to devote their time and energy to more pressing issues than application installations, an often simple yet time-consuming task. Remote application of this procedure gets the NRAO one step closer to a common computer environment as applications can now be installed in the same manner and configuration across the four sites.

Another goal defined at the Green Bank meeting was the installation of Windows Server 2003 on all of our Active Directory (AD) servers. The urgency behind the "pilot project" was motivation for a fast deployment, which was completed in late May. After a few weeks of troubleshooting minor migration issues, the AD domain officially moved out of testing phase and into production. At this time, all user accounts have been migrated from the existing NRAO domain to the new AD domain. Even though the accounts have been migrated, there is still physical interaction that must be done at each machine to

complete the migration process. This provides the Windows administrators the ability to give NRAO users a one-on-one tour through the new features offered in AD. The migration to AD is a big step in being able to use centralized authentication, as LDAP is the backbone of AD.

Finally, the documentation of the Windows CCE project has been improved extensively. This documentation has been collated and properly organized on the internal web pages for NRAO employees and computer system administrators to consult.

While the Project Office pilot project development and testing is proceeding successfully in Charlottesville, a new test system has been commissioned. In mid-May the Project Management Control System (PMCS) was deployed in Tucson. This system is serving as the test-bed for the final implementation that will be installed in Santiago, Chile in mid-November.

The CCE groups are continuing their regular video conference meetings and e-mail discussions; this is a vital part of the effort required to ensure the individual environments at each site stay well coordinated. The Wiki server is now in active use to track operational targets, collaborative development, and discussion of issues.

Web Infrastructure

Milestones	Original Date	Revised Date	Date Completed
Plan Web Server upgrade to RedHat 9	03/01/04	04/30/04	04/01/04
Provide secure webmail for NRAO staff	05/01/04		05/01/04
Provide collaborative 'wiki' for NRAO	05/01/04		05/01/04
Purchase proxy servers for CDL	06/05/03		05/06/04
Provide second public 'wiki'	07/31/04		
Test RedHat 9 server with NRAO web configuration	08/31/04		
Evaluate additional Groupware	04/01/04	09/30/04	
Purchase proxy servers for VLA	06/05/03	12/31/04	

A web "proxy" or caching server for the NRAO Technology Center in Charlottesville has been installed and will become operational in the coming quarter. The purchase and installation of a similar server for the VLA site has been postponed, pending a re-organization of the network routing infrastructure in New Mexico. These servers help to reduce the NRAO's overall bandwidth requirements between sites, and to the Internet; they also speed up performance, and provide improved transparency for the web content mirroring system.

Computing and Information Services

The disk capacity of the web server in Charlottesville was nearing critical levels, so a plan to increase this by 50% was devised and implemented. Because this server hosts more "virtual servers" and content than any of the other three identical systems at the other NRAO sites, demands on its disk and overall capacity are likely to increase. The system is now fully populated with disk hardware, and more disk space can only be added by replacing disks with higher capacity units. It is crucial that this server be upgraded within two years; because of the identical layout on the other three servers, it does not make sense to upgrade one without doing likewise on all four systems.

The planning for the upgrade to Red Hat 9 on the web servers is complete, and the web administrator group has moved on to the testing phase. The "sparerib" server in Green Bank is being used to test out the standard NRAO web services layout. Once the configuration has been validated, we will proceed to upgrade the main servers to Red Hat 9.

Evaluation of web-enabled groupware solutions has, as mentioned in the previous report, temporarily halted, pending the testing and evaluation of the pilot Microsoft Exchange/Outlook calendar project by the NRAO Program Office. Due to issues beyond the control of the web administration group, the web-based testing of this pilot project by Unix/Linux users has been pushed back into the coming quarter.

The Secure WebMail portal has entered production mode, and has rapidly become a popular and vital part of the NRAO's mail and web infrastructure. Its ease of use, combined with its inherent security and low maintenance overhead, has resulted in a significant return on the initial investment of time by the web administrators. Several minor enhancements are planned for this service throughout the remainder of the year.

The "wiki" has also entered its mainstream production mode, and is in active use by several groups around the observatory. Its popularity has led to requests for a second such service, this time not restricted to the NRAO's intranet. Plans for this second wiki are under way, and it should be available before the end of the coming quarter.

The existing web-based Calendar Publication service ("WebEvent") operated on the Tucson web server is being migrated to Charlottesville. This has been largely driven by the transfer of the staff member responsible for its installation and maintenance to the North American ALMA Science Center. During this migration, the database services inherent in the calendar will be moved to a secure, internal-only database server in Charlottesville; the previous configuration in Tucson had the database server running on the same system as the web server. Separation of these two services will provide increased security, and is in line with standard industry practices.

Finally, the web administration group is starting to consider what the next generation of web services (hardware and software) for NRAO should look like. The existing mirroring scheme for the content of the main server (www.nrao.edu) is adequate, but not scalable for any significant expansion. To properly design and implement such a plan, significant involvement needs to be guaranteed from the participants. The current staffing level is inadequate for any reasonable effort.

Charlottesville Computing

Milestones	Original Date	Revised Date	Date Completed
Upgrade Linux clients to RedHat 9	03/31/03	06/28/04	06/28/04
Upgrade Linux servers to RedHat 9	04/30/04	07/31/04	
Mailing list software version upgrade	07/31/04		
Migrate Tacacs authentication	06/30/04	08/31/04	
Upgrade Windows systems to Windows XP	06/30/03	09/30/04	
Populate inventory database	05/15/04	09/30/04	

Coping with the computers moves that accompany office moves counted for a large portion of effort in the division this quarter. These office moves result from the interior construction and remodeling work associated with the Edgemont Road (Stone Hall) building addition. More such relocations are anticipated through the rest of the calendar year and beyond. Also, a significant influx of employees relocating from the NRAO's Tucson office resulted in additional workload.

Operating system upgrades proceeded at an accelerated pace through the quarter; virtually all relevant desktop systems are now at Red Hat 9, and a large portion of Windows desktops have been upgraded to Windows XP. Upgrading the servers is proceeding in a cautious and steady manner.

The planned migration of the computer inventory spreadsheet mentioned in the previous report to the Track-it database has proven problematic. An alternative system based on easily customizable scripts and text files is in place and being fine-tuned to provide the desired solution with significantly less effort.

The software that controls the ~200 mailing lists for NRAO ("mailman") will be upgraded to a newer, more functional version in the coming quarter. This should permit significantly improved control over the operation of the lists to the respective mailing list owners.

Work continued on the pilot program to implement and evaluate use of a Microsoft exchange server based calendaring system, on behalf of the NRAO Program Office. The server is in use and testing by other NRAO staff is proceeding.

Computing and Information Services

Observatory-wide Communications

Milestones	Original Date	Revised Date	Date Completed
Upgrade network services to VLBA HN, OV antennas	04/01/04	04/30/04	04/20/04
Add video conference unit in NTC	05/31/04		05/31/04
Begin network wiring for Stone Hall extension	06/30/04		06/25/04
Add video conference unit in AOC West	08/31/04		
Upgrade network services to VLBA BR antenna	04/01/04	09/30/04	
Upgrade network services to VLBA KP antenna	12/31/02	09/30/04	
Upgrade network services to VLBA SC antenna	09/30/04		
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 permission to begin pulling the cables in June. The first phase will be to wire the newly constructed areas. Since the completed building will have the main communications room in a more central location, all of the cabling from the existing rooms must be run to the new location. This must be complete before the building is occupied; the presently scheduled date for this is early December.

As a result of lower costs for our intranet contract with AT&T, we have decided to upgrade the service at four VLBA sites. A two-month delay was incurred due to a problem in the AT&T order processing. However, the upgrade to T1 (1.544 Mbps) access was completed at two of the sites (Hancock and Owens Valley). Although AT&T accepted the order to upgrade the service to Brewster, the Local Exchange Carrier cannot provide the circuits into the site. We are continuing to explore different options to achieve this service. AT&T has also accepted the order to provide fractional T1 (at 384 kbps) to the St. Croix antenna.

A significant effort was spent in the last two quarters ironing out billing inconsistencies with our major telecommunication providers MCI and AT&T, who provide the services through the Federal Technology Service of the General Service Administration. Fortunately, these issues are now largely resolved.

Computing and Information Services

The NRAO video system is routinely used to relay scientific and technical colloquia throughout the Observatory. Two new locations will be added to the system. A new video unit had been added to the NTC in the penthouse conference room, and a new unit has been purchased for the AOC West facility in New Mexico. The biggest remaining deficiency for interactive multi-site video between the auditoria is the auditorium sound systems. This will be addressed on a best-effort basis over the next few months. However, this project has also been significantly delayed because of the effort being re-assigned to the building projects.

Education and Public Outreach

Education and Public Outreach Highlights

"Doing Dishes" a NASA IDEAS funded teacher workshop was held in Socorro in June, laying the foundations for an ongoing 2-week astronomy class which will be offered every other year at New Mexico Tech. Both community and media outreach did well this quarter with a VIP tour of Green Bank by prominent Charlottesville residents, a major regional planetarium conference coming to Charlottesville to learn about the NRAO, and significant local and regional news reports on the NRAO and its research results. VLA and Green Bank Gift shops continue to out perform original projections.

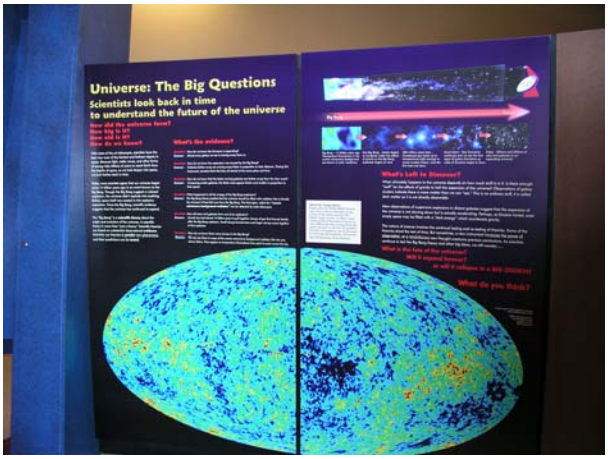
Informal Education

Attendance at the Science Center at Green Bank and at the VLA Visitor Center during spring has been more robust, as expected, than the previous three months of winter with Green Bank up by over 7,000 visitors and the VLA up by nearly 2,500. In addition to the usual seasonal change, both facilities also showed sizeable increases compared to the same quarter last year with Green Bank up by 56% and the VLA up by 136%. The VLA increase is probably due in large measure to now actually being able to count visitors rather than relying on a sign-in book. Yet, it is believed that there is also a real increase, not just a better counting increase. For the fiscal year, Green Bank attendance is more than double last year's count, while VLA attendance is 167% of what it was the previous year.

Site	April	May	June	Quarterly Total
Green Bank	1,203	3,131	5209	9,543
VLA	2,043	1,984	2,945	6,972

Changes and upgrades to exhibits continue at Green Bank and the VLA. New exhibits available to the visitors at Green Bank include "It takes a Village to do Radio Astronomy" about the different employee roles that are needed to make Green Bank operate, an "Expanding Universe" exhibit about the Big Bang and the Cosmic Background Radiation, and a Grote Reber Artifacts exhibit. At the VLA the grounds crew completed a new outdoor exhibit along the existing walking tour, a poured semi-circular curb to give visitors an idea of the size of a VLA antenna. In Charlottesville, planning is occurring for the enlarged lobby area on the renovated building scheduled to be completed at the end of the year. Plans currently call for exhibits on the basics of radio astronomy, descriptions of the NRAO including what we do, where we are located, the type of research done with our telescopes, and the North American ALMA Science Center. There will also be better directories for visitors and current results and events at the NRAO.

Education and Public Outreach



Top left: Part of the Expanding Universe exhibit, top right: Part of the Grote Reber Artifacts exhibit, bottom: a class experiencing the size of a VLA antenna.

Education and Public Outreach

The new gift shops at Green Bank and the VLA continue to perform well with increased revenue over the same periods compared to the previous year. Green Bank nearly doubled its quarterly revenue from the previous year, while the VLA increase was nearly six times as much. Some of the increase at the VLA was generated through extended summer gift shop hours which began in June. The revenue generated more than covers the cost of operating each gift shop, and the balance helps to support the ongoing education and outreach activities at both sites.

Gift Shop	April-June, 2003	April-June 2004
Green Bank	$21,385	$41,029
VLA	$6,642	$39,499

Café revenue at the Science Center at Green Bank is currently generating about 40% as much revenue as the gift shop does. June was the first month for which revenue could be compared to last year (it opened Memorial Day weekend 2003) and this June's revenue is more than double that of last June.

The recently completed student bunkhouse saw active use. During this quarter it was occupied for 16 nights by 8 groups comprised of 38 adults/chaperones and 183 students. Groups making use of the facilities included three college groups, four school groups, and one Boy Scout Troop. Green Bank also hosted a successful Director's VIP Tour targeted at making people from Charlottesville more aware of the existence and mission of the NRAO.

The Director's Charlottesville VIP tour of Green Bank.

There have been a number of changes and enhancements to the NRAO web pages. The Green Bank public pages have been significantly revised and updated as have the Charlottesville site pages, which now include a link to brand new North American ALMA Science Center pages as well as a photographic record of the ongoing construction at the Edgemont Road offices. Images of the construction at the Operations Support Facility for ALMA are also now available.

Education and Public Outreach

Formal Education

The two RET appointees, began their programs at Green Bank in June. One is involved with designing analysis tools for understanding pulsar data, while the other is working with the RFI workshop program mentioned below. In addition, the teacher designated for the RFI workshop also started his tour of duty in June.

The Green Bank's NASA IDEAS program, "Quiet Skies: Exploring Radio Astronomy and the Noisy World We Live In," will develop instrumentation and curriculum for 7-12 grade students to investigate the issue of radio frequency interference (RFI). The NRAO staff is working on the design for the initial Quiet Skies detectors, and is collaborating with teacher-interns to test, calibrate and modify the instruments and develop a curriculum. A larger group of teachers will field-test "Quiet Skies" with their students with the intent being expansion to statewide use in West Virginia and eventually nationally.

Groups using the 40-foot telescope this quarter included Behrend College, Concord College, Fairmont State College, Gettysburg College, Glenville State College, Linwood Holton Governor's School, Mountain Institute Summer Camp, North High School, Oil City High School, Penn State University – Erie, Rhema Christian Academy, Tygarts Valley High School, and Wheeling Day School.

The Socorro NASA IDEAS program, "Doing Dishes: Observational Radio Astronomy for Science Education," was held the first week in June. Eight New Mexico teachers worked with NRAO and New Mexico Tech (NMT) staff for lectures, hands-on activities, and actual observing using the Small Radio Telescope at the VLA Visitor Center site (remotely) and the interferometer and optical telescopes at Etscorn Observatory on the NMT campus. At the end of the week the teachers presented their research findings along with the implications of the program for their classrooms. With their evaluations and suggestions, NRAO and NMT have put together a two-week radio astronomy class for teachers to be offered through Tech's Master of Science Teaching program. The class will be offered every other summer, with the first session to be this summer, July 12-23, 2004.

Special activities at Green Bank included behind-the-scenes High Tech tours, Friday Films, Star Parties, and Exhibit Hall Scavenger Hunts. At the VLA the March quarterly public tour was successful in attracting 230 persons despite unpleasant weather conditions.

Community Relations

The NRAO support for science fair continued with nine or more employees supporting the New Mexico State Science Fair. The NRAO judges selected winners for special NRAO sponsored prizes at both the junior and senior levels. The NRAO also provided some judging for the local Green Bank science fair as well as participation in the district science/math/technology consortium. During this quarter, other activities included special tours at Green Bank, VLA tours, NTC tours, VIP tours, star parties, radio interviews, newspaper interviews, mentoring, BSA volunteers, social studies fairs, school

career day talks, and Chautauqua presenters. Staff also assisted EPO efforts with support for exhibit hardware, exhibit software, teacher workshops, and web content.

Although it was listed as an American Astronomical Society exhibit at the Sally Ride Science Fair at George Mason University, it was two NRAO employees (Rachel Osten and Charles Blue) who were tending the booth, giving demonstrations, and taking about radio astronomy with the young girls and their families who attended this event in April. This occasion was the spur for building a transportable radio telescope for use at schools and at such occurrences. The NTC was host to 10th graders from the Charlottesville area school districts who are interested in technology careers. This was the experimental first year of a program that organizers hope to expand in future years.

Both Green Bank and Charlottesville held morning observing sessions for the rare Venus transit in June. Green Bank's activities included a film showing, a special Starlab Planetarium show on the transit, and a public observing session. They also uncovered a local, direct descendent of David Rittenhouse, one of the few Americans to observe and record the transit of 1769. In Charlottesville, an observing session was held for NRAO staff members and family in which they battled early morning fog to observe the Sun. The observing session led to local television follow-up coverage of the transit.

A Sunspotter and a very small radio telescope in use behind the NRAO Technology Center on the foggy morning of June 8, 2004 observing the transit of Venus and the Sun.

Education and Public Outreach

Green Bank also hosted a public Star Party in April and installed ten new computers in the computer lab at the Science Center. Snowshoe Mountain Resort, about a half an hour from Green Bank, offers their guests a daily tour opportunity that includes a stop at the Science Center, and a van with such visitors has been appearing on almost a daily basis.

Astronomy Community

Significant NRAO staff effort also went into supporting the AAS conference in Denver in May. Public Information Officers, Chuck Blue and Dave Finley, assisted in the AAS Press Room with press conferences, aided the presenters, and provided reporters with accurate information about astronomy and NRAO activities. A new NRAO display booth was unveiled and staffed by NRAO employees attending the conference. There was one NRAO press conference at this meeting and several press releases.

At the behest of the NSF, NRAO had a display at the Spectrum Managers Association meeting in May. The NRAO will host an NSF Public Information Officers Workshop, with Dave Finley, NRAO Public Information Officer in Socorro the co-chairman for the workshop. The dates have been confirmed for October 21-22.

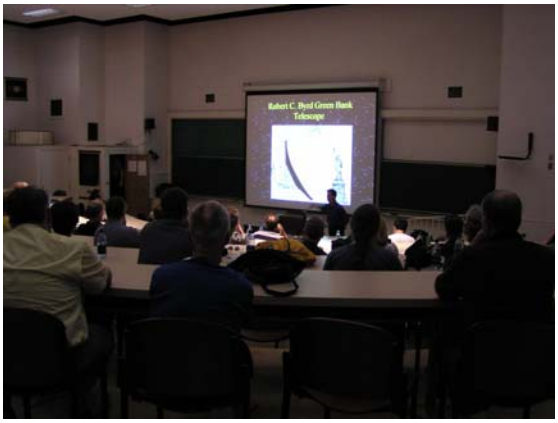
To meet the continuing needs of the Observatory, significant EPO staff effort was provided for producing the Newsletter, the Quarterly Reports, the Point Source, the ALMA Workshop, the Green Bank VIP tour invitations, posters for staff for different meetings, figures and images for presentations by scientists and engineers, and printed materials for Human Resources and observatory operations.

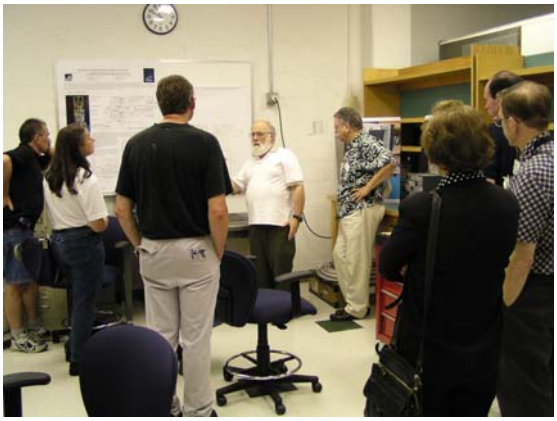
Media Relations

There have been six NRAO national press releases this quarter, including three at the AAS Meeting. An April release on a determination of the size of Sagittarius A* with the VLBA was picked up nationally and internationally by many outlets. Then in June, the GBT discovery of two new molecules also broke into the national news and stirred interest in Virginia. That same week, coincidentally, the Richmond paper ran a large feature story on the National Radio Quiet Zone and the GBT.

Two U.S. regional planetarium organizations (Southeast Planetarium Association-SEPA and the Mid-Atlantic Planetarium Society-MAPS) held a joint meeting in Richmond this June and visited Charlottesville. The group received a presentation on the NRAO, each participating individual received NRAO materials, and a smaller group returned after their visit to Monticello for an evening tour of the NTC.

Education and Public Outreach





Left, Chuck Blue describing some of the latest results with NRAO telescopes and right, Skip Thacker with some of the MAPS/SEPA participants touring the NTC.

National Geographic in different media has been recently looking at both the VLA and the GBT. The VLA was photographed by a video crew in connection with a SETI story on an upcoming National Geographic Channel documentary. The VLA was also scheduled to appear in the June issue of Sunset magazine.

Environment, Safety, and Security

Environment, Safety, and Security Highlights

Environment, Safety, and Security (ES&S) participated in the development of the ALMA project by review of key construction and procurement documentation. The construction activities at the ALMA ATF site have been replaced by operational safety issues and ES&S continues to provide oversight. At the VLA an Automated External Defibrillator (AED) was received from a grant applied for in December of 2003. The Wellness Program provided blood sampling to interested employees at the Green Bank site. Also at Green Bank, the high angle rescue team practiced their rescue skills on the GBT. The security surveillance cameras were tested for RIF and the mitigation process initiated with the use of screened camera dome covers.

ALMA

Environment, Safety, and Security (ES&S) reviewed the Fichtner documentation for the Operations Support Facility, OSF. The ALMA Back End (BE) Critical Design Review (CDR) was held this quarter and ES&S provided review on the documentation of the design. ES&S prepared a review and commentary on the construction documents for the BE specification.

The Joint ALMA Office prepared a job description for the ALMA Safety Officer. The interviews for the position were held in Charlottesville where four candidates were considered. Upon completion of the interviews, it was decided to consider additional applicants before making a final decision.

While the onsite activities at the ALMA ATF site have slowed considerably, ES&S continued to monitor the site for safety and security issues. The ES&S Office began exercising oversight of safety at the ATF, now that the AEC antenna is "operational" and under ALMA's control for testing. This included review and revision of the safety procedures written for the AEC antenna to reflect the antenna's operational status.

In May, ES&S participated in the technical review for the bids on the ALMA production antennas, concentrating on the safety aspects of each proposal.

Environment, Safety, and Security

NRAO-New Mexico

During this quarter there were multiple training sessions conducted on a number of safety related subjects. The monthly emissions were maintained for the 2003 EPA New Mexico Air Quality Bureau Emission Inventory.

During this quarter, the VLA ES&S Office received an Automated External Defibrillator (AED) from a grant that was applied for in December of 2003. The Site Safety Officer developed protocols for the AED. The protocols were submitted and approved by the AED medical director. The VLA Safety Officer also completed and submitted the rural emergency medical service training and equipment assistance program grant request for the NRAO/VLA Emergency Services group.

The development of the optical fiber laser safety program was initiated for the use of the EVLA fiber communication system. In addition, the Job Safety Analysis (JSA) was initiated for use of the steam cleaner/pressure washer at the request of the employee safety committee. Another JSA is in development for the VLA Track Crew for use, training, and maintenance of the Jackson 7000 rail tamper.

At the AOC, the semi-annual Halon fire suppression system, preventative maintenance, was completed. In support of the local community, the VLA Emergency Services group responded to a multiple vehicle accident on June 30, 2004 on U.S. Highway 60, west of the VLA site. The Emergency Services group provided valuable support during this incident.

NRAO-Green Bank

This period, the Green Bank cafeteria staff participated in Food Code training to ensure the proper care and sanitation in the preparation and delivery of food. The semi annual food safety inspection was conducted for the food service areas.

Safety training in Green Bank was conducted for the maintenance staff in the NRAO occupational noise and hearing protection program. Based on noise sampling results, several areas at the site were identified as potential areas where hearing protection is required. Semi-annual respirator fit testing was performed as well as training for lifeguard, and chemical hazard communication training.

The annual site safety inspection was conducted this quarter. The results of the inspection were provided to local Division Heads and Supervisors with a schedule for addressing the items identified.

The annual blood testing was provided for all interested employees. This program is part of the Health and Wellness effort designed to assist in identifying and flagging areas of potential concern in individual blood work samples.

Environment, Safety, and Security

With respect to the advancement of the site security system, RFI testing resolved the major issues associated with the installation of surveillance cameras at the Green Bank site. With close participation and support from the Green Bank RFI group, a successful solution was developed to screen the camera dome covers.

As pictured here, the members of the high angle rescue team participated in a full day exercise on the GBT where simulated rescue was performed.

NRAO-Charlottesville

The NRAO Workers Compensation program for Canadian employee(s) was established in coordination with Human Resources and Fiscal Divisions. This required the registration of the NRAO as an employer in Canada. The NRAO Business Continuity Program was evaluated with Administrative Services and the Directors Office. The objective of the Business Continuity Program is to provide for the recovery systems in the event of a loss of business services.

Telescope Usage

The NRAO telescopes were scheduled for research and maintenance during the second 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	1658.15	1190.25	1206
Scheduled Maintenance and Equipment Changes	217.5	246.2	409
Scheduled Tests and Calibration	345.0	348.6	555
Time Lost	115.4	46.2	91
Actual Observing	1542.75	1144.0	1115

GBT Observing Programs

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

	Observer(s)	Programs
BB183	Bower, G. (UC, Berkeley) Anderson, J. (Rice) Zhao, J-H (CfA) Goss, W. M. Falcke, H. (MPIfR) Backer, D. (UC, Berkeley)	Intrinsic size and morphology of Sgr A*
BB187	Black, G. (Virginia) Campbell, D. (Cornell)	Interferometric radar observations of Asteroid (25143) Itokawa. 11 cm
BK110	Kondratko, P. (CfA) Greenhill, L. (CfA) Lovell, J. (ATNFc/o COSSA) Kuiper, T. (JPL) Moran, J. (CfA) Jauncey, D. (ATNF)	Follow-up imaging of the water megamaser in NGC 3393. 1.3 cm
BU027	Ulvestad, J. Neff, S. (GSFC) Teng, S. (Maryland)	Monitoring young supernovae in Arp 299. 3.5, 11 cm
BW070	Walker, R. Wrobel, J. Ly, C. (Arizona)	High sensitivity observations of the M84 jet base.
GB049	Bartel, N. (York) Rupen, M. Bietenholz, M. (York) Beasley, T.A. (Caltech) Graham, D.(MPIfR) Altunin, V. (JPL) Venturi, T. (Instituto di Radioastronomia) Umana, G. (Istituto di Radioastronomia) Cannon, W. (York) Conway, J. (Onsala Space Observatory)	SN1993J: The center of the shell and its structural and spectral evolution. 6, 21 cm

GBT Observing Programs

	Observer(s)	Programs
GBT01A-061	Lane, W. (NRL) Briggs, F. (ANU) Chengalur, J. (NCRA (TIFR)) Kanekar, N. (Kapteyn Astronomical Inst.) Kassim, N. (NRL)	A blind search for redshifted HI 21 cm absorption. 50 cm
GBT01A-064	Cordes, J. (NAIC and Cornell) Lazio, T. (NRL) McLaughlin, M. (Manchester) Backer, D. (UC, Berkeley) Chatterjee, S. (Cornell) Kassim, N. (NRL)	Search for pulsars from point sources in the galactic center. 3.5 cm
GBT02A-017	Balser, D.	The galactic evolution of 4He: The dy/dz relation. 3.5 cm
GBT02A-028	Braatz, J. Langston, G. McMullin, J. Garwood, R.	Exploring the radio spectrum of Orion A and W51 50. 1.3, 2 cm
GBT02A-031	Lockman, F. J.	Galactic HI mapping of X-ray, UV, and optical deep fields. 21 cm
GBT02A-041	Rood, R. (Virginia) Bania, T. (Boston) Balser, D.	Stalking the cosmic 3-Helium abundance. 3.5 cm
GBT02A-046	Braatz, J. Henkel, C. (MPIfR) Wilson, A. (Maryland)	Monitoring a maser disk in Mrk 1419. 1.3 cm
GBT02A-063	Claussen, M. Wootten, H. A. Marvel, K. (AAS) Wilking, B. (Missouri)	Water maser monitoring of low-and intermediate-mass young stellar objects. 1.3 cm

GBT Observing Programs

	Observer(s)	Programs
GBT02A-069	Fisher, R.	Galaxy survey of HI emission. 21 cm
GBT02B-005	Yusef-Zadeh, F. (Northwestern) Roberts, D.(Northwestern) Maddalena, R.	Search for positronium recombination maser line emission toward the galactic center. 3.5, 21 cm
GBT02C-002	Carilli, C. Stocke, J. (Colorado) Menten, K. (MPIfR) Langston, G. Rector, T. Dwarakanath, K.	Redshifted HI 21 cm absorption towards red gravitational lenses (J0134-0931, J1004+1229).
GBT02C-012	Hollis, J. (NASA/GSFC) Lovas, F. (NIST) Jewell, P. Kisiel, Z. (Polish Academy of Sciences)	A search for the first nucleic acid base biomarker: interstellar pyrimidine. 1.3., 2 cm
GBT02C-043	Finkbeiner, D. (Princeton) Heiles, C. (UC, Berkeley) Schlegel, D. (Princeton) Frank, C. (Maryland)	Microwave emission from spinning dust. 1.3, 2, 3.5 cm
GBT02C-054	Braatz, J. Henkel, C. (MPIfR) Wilson, A. (Maryland) Greenhill, L. (CfA) Moran, J. (CfA)	Measuring nuclear disks in NGC 1386 and IC 2560 (H_2O). 1.3 cm
GBT03A-014	Lockman, F. J.	Halo HI Clouds: distribution and properties. 21 cm

GBT Observing Programs

	Observer(s)	Programs
GBT03A-015	Lane, W. (NRL) Kanekar, N. (Kapteyn Astronomical Inst.) Ellison, S. (ESO) Chengalur, J. (NCRA (TIFR))	A search for 21 cm absorption in high-redshift damped Lyman-Alpha absorbers. 50 cm
GBT03A-016	Stairs, I. (British Columbia) Manchester, D. (Australia Telescope) Lyne, A. (NRAL)	The physics of a massive pulsar system. 21 cm
GBT03B-011	Widicus, S. (Caltech) Blake, G. (Caltech) Braakman, R. (Caltech)	A search for sugars in hot cores. 1.3 cm
GBT03B-012	Brogan, C. (JCMT) Johnson, K. (Wisconsin) Claussen, M.	Search for "Kilojansky" water masers in four starburst galaxies. 1.3 cm
GBT03B-013	Yun, M. (Massachusetts) Schneider, S. (Massachusetts) Brinks, E. (INAOE) Bravo-Alfaro, H. (Universidad de Guanajuato)	An unbiased HI survey of the Coma Cluster and beyond. 21 cm
GBT03B-015	Ransom, S. (McGill) 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
GBT03C-002	Arzoumanian, Z. (NASA/GSFC) Nelemans, G. (Cambridge) Rupen, M.	The radio properties of the shortest-period binaries known. 1.3, 6 cm
GBT03C-009	Darling, J. (Carnegie Institution)	A direct measurement of fine structure "constant" evolution from OH and HI absorption lines. 50 cm

GBT Observing Programs

	Observer(s)	Programs
GBT03C-026	Fish, V. (CfA) Reid, M. (CfA) Menten, K. (MPIfR)	Hydroxyl absorption Zeeman splitting in massive star-forming regions. 2 cm
GBT03C-030	Chengalur, J. (NCRA (TIFR)) Kanekar, N. (Kapteyn Astronomical Inst.)	Constraining the variation of fundamental constants using 18 cm OH lines. 38 cm
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. (South Wales) Pihlstroem, Y Wiklind, T. (STSI) Francis, P. (Australian National U.)	Highly redshifted HI and OH absorption in red quasars. 50 cm
GBT04A-008	O'Neil, K.	New HI galaxy standards. 21 cm
GBT04A-019	Henkel, C. (MPIfR) Braatz, J. Menten, K. (MPIfR) Carilli, C.	Molecular line absorption in a distant radio source. 2 cm
GBT04A-022	Moore, T. (Liverpool JMU) Porter, J. (Liverpool JMU) Jones, H. (Liverpool JMU)	Variations in star-formation efficiency in the W3 GMC. 1.3 cm
GBT04A-025	Liszt, H. Lockman, F. J. Rupen, M. Pidopryhora, Y. (Ohio)	Physical properties of halo HI clouds. 21 cm

GBT Observing Programs

	Observer(s)	Programs
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
GBT04A-041	Margot, J. (Cornell) Peale, S. (UC, Santa Barbara) Slade, M. (JPL)	The interiors of Mercury and Venus from their spin dynamics. 3.5 cm
GBT04A-045	Roberts, M. (McGill) Hessels, J. (McGill) Ransom, S. (McGill) 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-050	Lane, W. (NRL) Fisher, R. Darling, J. (Carnegie Institution)	Feasibility study for a measurement of variable redshifted absorption. 21 cm
GBT04A-051	Remijan, A. (NASA/Goddard) Hollis, J. (NASA/GSFC) Jewell, P.	Confirming ethylene glycol in comets LINEAR and NEAT. 2 cm
GBT04B-007	Law, C. (Northwestern) Yusef-Zadeh, F. (Northwestern) Maddalena, R. Cotton, B.W. Roberts, D. (Northwestern)	A study of the Galactic Center lobe. 3.5, 6 cm
GBT04B-015	Campbell, D. (Cornell) Margot, J. (Cornell) Carter, L. (Cornell) Campbell, B. (Smithsonian Institute)	Mapping the topography of Maxwell Montes on Venus. 11 cm

GBT Observing Programs

	Observer(s)	Programs
GBT04B-017	Lovell, A. (Agnes Scott College) Schloerb, F. (Massachusetts) Howell, E. (Arecibo Observatory)	OH observations of long-period comets. 21 cm
GBT04B-019	Cecil, G. (North Carolina) Christiansen, W. (North Carolina) Hawthorn, J. (Anglo-Australian Obs.)	Mapping the Milky Way's superwind bubbles. 2, 6, 11 cm
GBT04B-025	Butler, B. Wootten, H. A. Palmer, P. (Chicago)	Observing NH3 and OH in comets Q4 NEAT and T7 LINEAR. 1.3 cm
GBT04B-029	Stairs, I. (British Columbia) Camilo, F. (Columbia Astrophysics Lab.) Kramer, M. (NRAL) Faulkner, A. (Nuffield Radio Astro. Lab.) 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

GBT Observing Programs

	Observer(s)	Programs
GBT04B-035	Camilo, F. (Columbia Astrophysics Lab.) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Stairs, I. (British Columbia) Possenti, A. (Osservatorio di Cagliari) Kramer, M. (NRAL) Manchester, D. (Australia Telescope) Joshi, B. (NCfRA (India)) Freire, (Arecibo Observatory) Lyne, A. (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. 2, 6, 3.5, 11, 21 cm
GM051	Mack, K.-H. (ASTRON) Snellen, I. (RO, Edinburgh) Vermeulen, R. (Stichting ASTRON) Schilizzi, R. (JIVE) Klockner, H. (Kapteyn Institute)	VLBI HI-absorption observations of a complete sample. 21 cm
GV017	Kanekar, N. (Kapteyn Astronomical Inst.) Vermeulen, R. (Stichting ASTRON) Chengalur, J. (NCRA (TIFR)) Ghosh, T. (Arecibo Obseratory)	The physics of an OH megamaser at z = 0.25. 21 cm

VLA Observing Programs

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

	Observer(s)	Programs
AB1093	Blundell, K. (Oxford) Rawlings, S. (Oxford)	High-z FRI quasars. 20 cm
AB1097	Bietenholz, M. (York U.) Keohane, J. (NASA/GSFC) Chen, J. (North Carolina) Massenburg, S. (North Carolina)	Expansion of 3C58 supernova remnant. 20 cm
AB1112	Becker, R. (UC, Davis) Helfand, D. (Columbia) White, R. (STScI) Giveon, U. (UC, Davis)	Completing a Milky Way survey at 5 GHz. 6 cm
AB1114	Beltran, M. (CfA) Cesaroni, R. (Arcetri) Codella, C. (CNR/IRA-Frascati) Furuya, R. (Arcetri) Testi, L. (Arcetri)	Class I methanol masers toward high-mass YSOs in G24.78+0.08. 0.7 cm
AB1115	Butler, B. Gurwell, M. (CfA) Perley, R. Readhead, A. (Caltech)	Determining the effective bulk dielectric constant of Mars from 6 cm to 7 mm. 0.7,1.3, 2, 3.5, 6 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
AC669	Castelletti, G. (IAFE) Brogan, C. (Hawaii) Dubner, G. (IAFE) Kassim, N. (NRL)	Low frequency observations toward W44. 90, 400 cm

VLA Observing Programs

	Observer(s)	Programs
AC681	Cannon, J. (Minnesota) Skillman, E. (Minnesota)	Continuum emission in the low-metallicity galaxy I Zw 18. 3.6 cm
AC682	Clarke, T. (Virginia) Kempner, J. (Virginia)	Radio-X-ray power relation for cluster radio halos. 90 cm
AC696	Clarke, T. (Virginia) Kempner, J. (Virginia)	Radio halos in clusters of galaxies. 20 cm
AC699	Cohen, A. (NRL) Feretti, L. (Bologna) Kassim, N. (NRL) Orru, E. (Bologna) Lazio, J. (NRL) Lane, W. (NRL)	Cluster halos and relics from 74-MHz survey. 20 cm
AC706	Clarke, T. (Virginia) Sarazin, C. (Virginia)	Polarimetric and spectral-index study of cluster Abell 520. 90 cm
AC709	Chaves, T. (Queens) Irwin, J. (Queens)	HI in four edge-on spiral galaxies. 20 cm
AC711	Clarke, T. (Virginia) Sarazin, C. (Virginia) Blanton, E. (Virginia)	Spectral-index study of cluster Abell 115. 90 cm
AC718	Chyzy, K. (Jagellonian) Soida, M. (Jagellonian) Bomans, D. (Ruhr U.) Beck, R. (MPIR, Bonn)	Polarimetry of stripped Virgo Cluster spiral NGC 4569. 20 cm
AC723	Chung, A. (Columbia) Bureau, M. (Columbia) vanGorkom, J. (CfA) Koribalski, B. (CSIRO)	HI kinematics of spirals with counter-rotating ionized gas. 20 cm

VLA Observing Programs

	Observer(s)	Programs
AC724	Chambers, K. (IfA) McGrath, E. (IfA)	Luminosity dependence of high redshift cut-off of the millijansky radio source population. 3.5 cm
AC729	Cool, R. (Univ. Arizona) Dale, D. (Univ. of Wyoming) Bloom, S. (NASA/GSFC)	Spectral energy distributions of possible gamma-ray blazars. 1.3, 2, 3.6, 6 cm
AC732	Choi, M. (SA/IAA, Taiwan) Kim, K-T. (Illinois) Evans, N. (Texas) Wu, J. (Texas)	Ammonia kinematics in high-mass star-forming cores. 1.3 cm
AC733	Chen, Y. (CfA) Zhang, Q. (CfA) Wang, Y. (Texas) Beuther, H. (MPIR, Bonn) Sridharan, T. (CfA) Hunter, T. (CfA) Wu, Y. (Peking Obs) Ho, P. (CfA) Zapata, L. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM)	Ammonia kinematics in massive protostellar candidates. 1.3 cm
AC736	Chung, A. (Columbia) vanGorkom, J. (CfA) Bureau, M. (Columbia) Koribalski, B. (CSIRO)	Kinematic study of spirals with counter-rotating gas. 20 cm
AC739	Claussen, M. Marvel, Kevin (AAS) Wilking, B. (UMSL) Wootten, H.A.	Confirmation and position of a weak water maser (Target of Opportunity). 1.3 cm

VLA Observing Programs

	Observer(s)	Programs
AD485	Dolag, K. (MPIAP, Munich) Govoni, F. (Bologna) Readhead, T. (Caltech) Schindler, S. (Liverpool JMU) Feretti, L. (Bologna)	Magnetic fields in clusters of galaxies. 3.6 cm
AD490	Dyer, K. (North Carolina) Owen, F.	Spectral indices of Abell 13 at low frequencies. 20 cm
AD497	Dalcanton, J. (Washington) Rosolowsky, E. (Calif., Berkeley) Tavarez, M. (Univ. of Michigan) Hibbard, J.	HI structure and kinematics of edge-on late-type disk galaxies. 20 cm
AD498	DeLaney, T. (Minnesota) Rudnick, L. (Minnesota) Sankrit, R. (Johns Hopkins) Blair, W. (Johns Hopkins) Petre, R. (NASA/GSFC) Harrus, I. (NASA/GSFC)	Proper motions within Kepler's supernova remnant. 6, 20 cm
AE151	Emonts, B. (Groningen/Kapteyn) Morganti, R. (NFRA) vanderHulst, J. (Groningen/Kapteyn) Oosterloo, T. (NFRA) Tadhunter, C. (Sheffield) vanMoorsel, G.	HI observations of radio galaxies. 20 cm
AF405	Feretti, L. (Bologna) Orru, E. (Bologna) Brunetti, G. (Bologna) Giovannini, G. (Bologna) Girardi, M. (Trieste) Govoni, F. (Bologna)	Spectral indices of radio halos in clusters A2219 and A2744. 90 cm

VLA Observing Programs

	Observer(s)	Programs
AF412	delaFuente, E. (Guadalajara) Kurtz, S. (Mexico/UNAM) Hofner, P. (Puerto Rico) Araya, E. (Puerto Rico)	Ammonia and CS in the G12.21-0.10 hot molecular core. 0.7, 1.3 cm
AG632	Govoni, F. (Bologna) Murgia, M. (Bologna) Feretti, L. (Bologna) Giovannini, G. (Bologna) Dallacasa, D. (Bologna) Taylor, G.	Cluster magnetic fields via radio halos and RMs: A2255. 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
AG658	Gaensler, B. (CfA) Brogan, C. (Hawaii) Kassim, N. (NRL) Lazio, T. (NRL) Gelfand, J. (CfA)	90 cm survey of the inner galaxy. 90 cm
AH836	Hunter, D. (Lowell Obs) Elmegreen, B. (IBM) Brinks, E. (Guanajuato U.) Westpfahl, D. (NMIMT) Nordgren, T. (Lowell Obs) Wilcots, E. (Wisconsin) McIntyre, V. (Sydney) Ostlin, G. (Uppsala obs)	HI observations of normal irregular galaxies: Sextans. 20 cm
AH841	Hibbard, J.	HI structure and kinematics in merging systems. 20 cm

VLA Observing Programs

	Observer(s)	Programs
AH842	Hofner, P. (Puerto Rico) Linz, H. (Puerto Rico) Araya, E. (Puerto Rico) Kurtz, S. (Mexico/UNAM)	Circumstellar emission from protostar IC1396N-VLA2. 0.7, 1.3, 3.6 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
AJ312	Jimenez-Serra, I. Martin-Pintado, J. (Yebes Obs) Chandler, C. dePree, C. (Agnes Scott) Rodriguez-Franco, A. (CSIC)	Hot spot near Cep A HW2. 0.7 cm
AK563	Kenney, J. (Yale) van Gorkom, J. (Columbia) Vollmer, B. (MPIR, Bonn) Chung, A. (Columbia)	Virgo cluster, a laboratory for studying galaxy evolution. 20 cm
AK573	Kulkarni, S. (Caltech) Berger, E. (Caltech) Frail, D. Soderberg, A. (Caltech)	Radio afterglows of GRBs: progenitors and central engines. 0.3, 0.7, 1.3, 2, 3.6, 6, 13, 18, 20, 90 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
AK578	Kannappan, S. (Univ. of Texas) Matthews, L. Bash, F. (Univ. of Texas)	HI imaging of SO disks and their environments. 20 cm

VLA Observing Programs

	Observer(s)	Programs
AK581	Kothes, R. (DRAO) Landecker, T. (DRAO) Wolleben, M. (DRAO)	Kinematic distances to seven SNR through HI absorption. 20 cm
AL597	Laing, R. (Oxford) Bridle, A. Parma, P. (Bologna)	Spectrum of 3C31 from 74 to 8400 MHz. 3.6, 6, 20 cm
AL617	Law, C. (Northwestern) Yusef-Zadeh, F. (Northwestern) Cotton, W.D. Maddalena, R. Roberts, D. (Northwestern)	The Galactic Center lobe. 6, 20 cm
AL620	Levy, L. (UNC) Rose, J. (UNC) vanGorkom, J (CfA)	HI structure and kinematics of galaxies in Pegasus I cluster. 20 cm
AL622	Lockman, F. Pidopryhora, Y. (Ohio Univ.) Liszt, H. Rupen, M.	Physical properties of HI clouds in Galactic halo and disk. 20 cm
AL624	Lang, C. (Iowa) Johnson, K. (Wisconsin) Goss, W. M. Rodriguez, L. (Mexico/UNAM)	Compact sources in Quintuplet Cluster. 0.7, 1.3 cm
AL625	Lang, C. (Iowa) Figer, D. (STScI) Najarro, F. (CSIC)	Structure and spectra of luminous blue variable stars. 0.7, 1.3, 3.6 cm

VLA Observing Programs

	Observer(s)	Programs
AM766	Monnier, J. (CfA) Greenhill, L. (CfA) Tuthill, P. (Sydney) Danchi, W. (NASA/GSFC)	Monitoring colliding wind binary WR112. 3.6 cm
AM788	Mundell, C. (Liverpool JMU) Wilson, A. (Maryland) Schinnerer, E. Wilcots, E. (Wisconsin) Ulvestad, J.	HI imaging survey of Seyfert galaxies. 20 cm
AM789	Morganti, R. (NFRA) vanGorkom, J. (CfA) vanBreugel, W. (LLNL) Oosterloo, T. (NFRA)	HI observations of Minkowski's Object. 20 cm
AM790	Matthews, L.CfA) Bureau, M. (Columbia)	HI structure and kinematics of edge-on spiral UGC 10043. 20 cm
AM793	Monnier, J. (CfA) Greenhill, L. (CfA) Tuthill, P. (Sydney) Danchi, W. (NASA/GSFC)	Continuum monitoring of colliding wind binary WR 112. 3.6 cm
AM794	Machalski, J. (Jagellonian) Jamrozy, M. (Bonn U.) Koziel, D. (Jagiellonian)	Mapping the radio lobes in giant radio galaxies. 6 cm
AM795	Manthey, E. (Bochum) Huttemeister, S. (Bochum) Aalto, S. (Chalmers, Onsala)	HI distribution in mergers with moderate FIR luminosity. 20 cm
AM799	Montero-Castano, M. (Madrid Obs) Herrnstein, R. (CfA) Ho, P. (CfA)	HC3N imaging around Sgr A*. 0.7 cm

VLA Observing Programs

	Observer(s)	Programs
AM800	Miller, E. (Michigan) Bregman, J. (Michigan)	HI mass of high velocity clouds in nearby spiral galaxies. 20 cm
AO179	Osten, R. Hawley, S. (Michigan State). Bastian, T.	Radio emission from nearby brown dwarfs. 3.6 cm
AO181	Olofsson, H. (Stockholm Obs) Schoier, F. (Stockholm Obs) Kerschbaum, F. (Stockholm Obs) Lindqvist, M. (Chalmers, Onsala) Wong, T. (Calif., Berkeley)	SiO emission from winds of O-rich AGB stars. 0.7 cm
AO182	Omar, A. (Raman Institute) Dwarakanath, K. (Raman Institute)	HI search around HI deficient galaxies in Eridanus group. 20 cm
AO184	Osten, R. Hawley, S. (Washington) Hawley, S. (Michigan State) Bastian, T. Reid, I. (STScI)	Continuum emission from nearby cool stars and brown dwarfs. 3.6 cm
AP465	Pillai, T. (MPIR, Bonn)) Wyrowski, F. (MPIR, Bonn) Thompson, M. (Kent) Gibb, A. (Maryland) Hatchell, J. (MPIR, Bonn) Beuther, H. (MPIR, Bonn)	Water masers toward massive protostars. 1.3 cm
AP474	Palau, A. (Barcelona) Estalella, R. (Barcelona) Anglada, G. (IAA, Andalucia)	Ammonia and continuum toward IRAS00213. 0.7, 1.3 cm

VLA Observing Programs

	Observer(s)	Programs
AR523	Rupen, M. Dhawan, V. Mioduszewski, A. Ribo, M. (Barcelona)	X-ray binaries, transients and related sources. 0.7, 1.3, 2, 3.6, 6, 20 cm
AR535	Ribo, M. (Barcelona) Mirabel, I. (CNRS, France) Rodriguez, J. (ISDC Switzerland) Hannikainen, D. (Helsinki)	VLA/INTEGRAL/RXTE monitoring of GRS1915+105. 3.6, 20 cm
AR536	Rudnick, L. (Minnesota) Delain, K. (Minnesota)	Structures and spectral indices of WISH sources. 20, 90 cm
AR538	Reipurth, B. (Hawaii) Rodriguez, L. (Mexico/UNAM)	Survey of multiple, low-mass protostellar systems. 0.7 cm
AR539	Reid, M. (CfA) Menten, K. (MPIR, Bonn) Xu, Y. (Shanghai Obs) Zheng, X. (Nanjing) Moscadelli, L. (Bologna)	Parallaxes and proper motions of massive star-forming regions. 2, 6 cm
AR545	Rupen, M. Mioduszewski, A. Dhawan, V.	Monitoring of X-ray binaries etc. 0.7, 1.3, 2, 3.6, 6, 20 cm
AR547	Roberts, M. (Stanford) Brogan, C. (Hawaii)	90 cm imaging of the x-ray discovered SNR G7.4-1.4. 90 cm
AR548	Rodriguez-Rico, C. (Mexico/UNAM) Goss, W.M.. Zhao, J. (CfA) Viallefond, F. (Paris Obs) Turner, J. (UCLA) Mohan, N. (Raman Institute) Gomez, Y. (Mexico/UNAM)	H53alpha study of supernebula in NGC5253. 0.7 cm

VLA Observing Programs

	Observer(s)	Programs
AR549	Rho, J. (Caltech) Goss, W.M. Green, A. (Sydney)	Candidate SNR discovered by Spitzer. 6, 20 cm
AS762	Sokoloski, J. (Southampton) Mioduszewski, A. Brocksopp, C. (MSSL) Rupen, M.	Monitoring symbiotic binaries during outburst. 3.6, 6, 20 cm
AS780	Schinnerer, E. Rupen, M. Kennicutt, R. (Arizona)	Spectral-index study of M51 on 100-pc scale. 3.6 cm
AS786	Scuderi, S. (Bologna) Markova, N. (Bulgary) Puls, J. (Sternwarte) Stanghellini, C. (Bologna)	Spectra of thermal winds from O stars. 0.7, 2, 3.6, 6 cm
AS787	Schinnerer, E. Mundell, C. (Liverpool JMU) Garcia-Burillo, S. (Obs. National) Combes, F. (Paris Obs) Ulvestad, J.	Further HI imaging of CO-selected galaxies. 20 cm
AS791	Sakelliou, I. (Birmingham) Giovannini, G. (Bologna) Feretti, L. (Bologna) Ponman, T. (Birmingham)	Imaging the candidate radio halo in Abell 399. 20 cm
AS793	Schreyer, K. (Jena U.) Linz, H. (Puerto Rico) Hofner, P. (Puerto Rico) Araya, E. (Puerto Rico) Stecklum, B. (Thuringian)	Molecules and dust in disk candidate AFGL490. 0.7 cm

VLA Observing Programs

	Observer(s)	Programs
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
AS800	Sjouwerman, L. Messineo, M. (Leiden) Habing, H. (Leiden) Honma, M. (NAO, Japan) Imai, H. (NFRA)	Monitoring circumstellar SiO masers near Sgr A*. 0.7 cm
AS805	Shirley, Y. Evans, N. (Texas)	Search for continuum emission from L1014-SMM1, a mid-IR source. 3.6, 6 cm
AS809	Sollins, P. (CfA) Ho, P. (CfA) Zhang, Q. (CfA) Keto, E. (CfA)	Ammonia search toward two hot molecular cores. 1.3 cm
AT297	Tang, Y-W. Kuo, C-Y. Ho, P. (CfA) Lim, J. (SA/IAA, Taiwan)	Imaging the extended HI envelope around the M51 group. 20 cm
AU098	Umana, G. (Bologna) Buemi, C. (Bologna) Trigilio, C. (Bologna) Leto, P. (Bologna)	Radio spectrum of LBV candidate IRAS 18576+0341. 0.7, 1.3, 2, 3.6, 6, 20 cm
AV265	Vogt, C. (MPIA) Clarke, T. (Virginia) Ensslin, T. (MPIfEP, Garching)	Faraday rotation measure of extended radio sources. 20 cm

VLA Observing Programs

	Observer(s)	Programs
AV271	VandenBout, P. Carilli, C. Walter, F. Solomon, P. (SUNY) Bertoldi, F. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Cox, P. (IAP, Paris) Beelen, A. (IAP, Paris)	Search for HCN in FIR luminous galaxies at z~3. 0.7, 1.3 cm
AV272	VanTrung, D. (SA/IAA, Taiwan) Lim, J. (SA/IAA, Taiwan)	Cyanopolyynes in carbon-rich stellar envelopes. 0.7, 1.3 cm
AV275	Verdes-Montenegro, L. (IAA, Andalucia) Yun, M. (Massachusetts) Ponman, T. (Birmingham)	Atomic gas distribution of very HI-deficient compact groups. 20 cm
AW605	Walter, F. Brinks, E. (Guanajuato U.) de Blok, E. (Univ. Cardif) Thornley, M. (Bucknell) Kennicutt, R. (Arizona)	HI structures of nearby galaxies. 20 cm
AW618	Wilcots, E. (Wisconsin) Prescott, M. (Wisconsin)	Dynamics of Magellanic spirals NGC 4618 & NGC 3664. 20 cm
AW619	Wilcots, E. (Wisconsin) Sanders, W. (Wisconsin) Doane, N. (Wisconsin)	Continuum and HI imaging of NGC 4395. 6, 20 cm
AW621	Walter, F. Skillman, E. (Minnesota) Brinks, E. (Guanajuato U.)	HI observations of transition type dwarfs in M81 group. 20 cm

VLA Observing Programs

	Observer(s)	Programs
AW622	Walter, F. Carilli, C. Lo, K.Y. (SA/IAA, Taiwan) Bertoldi, F. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Fan, X. (Princeton) Omont, A. (IAP, Paris)	Search for molecular gas in quasars at z > 6. 0.7 cm
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. 0.7, 90 cm
AW632	Westmeier, T. (RAIUB) Bruns, C. (Bonn U.) Richter, P. (IAEF)	HI imaging of fragment of high-velocity cloud complex L. 20 cm
AW633	Walter, F. Brinks, E. (Guanajuato U.) Skillman, E. (Minnesota)	Blind search for low-mass HI clouds in 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
AZ143	Zhao, J. (CfA) Herrnstein, R. (CfA) Goss, W.M. Bower, G. (Calif., Berkeley) Pegg, J. (CfA)	Monitoring quasi-periodic oscillations of SgrA*. 0.7, 1.3, 2 cm

VLA Observing Programs

	Observer(s)	Programs
AZ149	Zapata, L. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Ho, P. (CfA)	Radio spectra of massive protostars. 1.3, 3.6 cm
AZ151	Zhao, J. (CfA) Pegg, J. (CfA) Lou, Y. (Tsinghua Univ.) Hong, X. (Shanghai Obs) An, T. (Shanghai Obs)	Monitoring the flux density variations of Sgr A*. 0.7, 1.3, 2 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

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. (NRO) Hachisuka, K. (Valencia) Honma, M. (NAOJ) Imai, H. (JIVE) Miyoshi, M. (NAOJ)	Measuring the transverse motion of a galactic evolved star. 2 cm
BB174	Bower, G. (Calif., Berkeley) Bolatto, A. (Calif., Berkeley) Plambeck, R. (Calif., Berkeley)	Trigonometric parallax of radio stars in the Orion Nebula. 2 cm
BB176	Boboltz, D. (USNO) Marvel, K. (AAS)	OH12.8-0.9: An overlooked water fountain? 1 cm
BB183	Bower, G. (Calif., Berkeley) Backer, D. (Calif., Berkeley) Falcke, H. (MPIR) Goss, W.M. Herrnstein, R. (Columbia) Zhao, J. (CfA)	Intrinsic size and morphology of Sag A*. .7 cm
BB186	Bignall, H. (JIVE) Black, G. (Virginia) Campbell, D. (Cornell) Ojha, R. (ATNF) Reynolds, C. (JIVE)	"Extreme" IDV Quasar PKS 1257-326: filling in the picture on milliarcsecond scales. 2, 4, 6 cm
BB187	Black, G. (Virginia) Campbell, D (Cornell)	Interferometric radar observations of Asteroid (25143) Itokawa. 13 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BB188	Brunthaler, A. (JIVE) Friedrichs, S. (MPIR) Fuhrmann, L. (MPIR) Krichbaum, T. (MPIR) Witzel, A. (MPIR) Zensus, J. (MPIR)	Position wandering due to interstellar scattering. 4,13 cm
BC120	Chatterjee, S. Backer, D. (Calif., Berkeley) Benson, J. Brisken, W. Cordes, J. (Cornell) Ellis, R. (Calif., Santa Cruz) Fomalont, E. Golden, A. (Ireland) Goss, W.M.. Kramer, M. (Manchester) Lazio, T. (NRL) Lyne, A. (Manchester) McKinnon, M. Thorsett, S. (Calif., Santa Cruz) Wong, D. (Cornell)	Pulsar astrometry with the VLBA. 20 cm
BC135	Cotton, W.D. Bakker, E. (Leiden) Chagnon, G. (DESPA) Coude du Foresto, V. (DESPA) Diamond, P. (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)	VLBA obs. of O-rich Mira stars. .7 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BC137	Cesaroni, R. (Arcetri) Beltran, M. (Arcetri) Codella, C. (Firenze) Furuya, R. (Arcetri) Moscadelli, L. (Cagliari) Testi, L. (Arcetri)	Study of H20 and OH masers tracing two bipolar outflows in the high-mass protocluster G24.78+0.08. 1 cm
BC139	Claussen, M. Beasley, A. (OVRO) Goss, W.M. Moellenbrock, G.	Tests of water maser phase referencing for astrometry of galactic water masers. 1 cm
BD087	Dhawan, V. Fomalont, E. Lestrade, J-F. (Obs. de Paris) Mioduszewski, A. Rupen, M.	VLB Astrometry of X-ray binaries. 0.4,13 cm
BD095	Darling, J. (Carnegie Obs) Carilli, C.	Precise constraint on cosmic evolution of the fine structure constant. 20 cm
BE036	Eisner, J (Caltech). Greenhill, L. (CfA) Menten, K. (MPIR) Moran, J. (CfA)	SiO masers and outflow from an obscured protostar in W51 IRS2. 0.7 cm
BF072	Fassnacht, C. (UC, Davis) 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.	Imaging and polarimetry survey. 2, 6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BG114	Gabuzda, D. (JIVE) Cawthorne, T. (Central Lancashire) Pushkarev, A. (ASC)	Toroidal B Fields in BL Lac objects. 2, 4, 6, cm
BG131	Gabuzda, D. (JIVE) Croke, S. (Cork) Vetukhnovskaya, Y. (ASC)	Nature of variable sheath structures surrounding the jets of compact AGN. 1, 2, 4, 6 cm
BG142	Gal-Yam, A. (Tel Aviv) Frail, D. Levinson, A. (Tel Aviv) Ofek, E. (Tel Aviv) Soderberg, A. (Caltech) Waxman, E. (Weizman Inst.)	An unidentified radio transient toward NGC 4216. 4, 20 cm
BG144	Gabuzda, D. (JIVE) Cronin, P. (Cork) Murray, E. (Cork)	Investigating the Toroidal B fields of BL Lac object jets. 2, 4, 6 cm
BH113	Hong, X. (ShAO) An, T. (ShAO) Jiang, D. (ShAO) Wang, W. (ShAO) Zhao, J. (CfA)	Millimeter VLBA observations of the core structure on a sub-parsec scale in AGN. 0.7, 2, 3 cm
BH118	Hough, D. (Trinity U.) Aars, C. (Trinity U.) Zensus, J. (MPIR, Bonn) Porcas, R. (MPIR, Bonn) Taylor, G.	Polarimetric imaging of lobe-dominated quasars. 2, 3.6, 6 cm
BH119	Hardcastle, M. (Bristol, UK) Worrall, D. (Bristol, UK) Pearson, T. (Caltech)	Proper motion and polarization of jet in CSS quasar 3C 48. 3.6, 6, 18 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BI028	Imai, H. (JIVE) Morris, M. (Calif., Los Angeles) Sahai, R. (JPL)	Kinematics of collimated molecular jets in evolved stars. 1 cm
BJ036	Jorstad, S. (Boston) Marscher, A. (Boston) Yurchenko, A. (St. Petersburg)	BL Lac objects with high proper motion. 2, 4, 7 cm
BJ046	Junor, B. (LANL) Owen, F. Eilek, J. Hardee, P. (Alabama) Walker, R.C.	M87 Jet at 25 mas resolution. 90 cm
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
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

VLBA Observing Programs

No.	Observer(s)	Programs
BK110	Kondratko, P. (CfA) Greenhill, L. (CfA) Lovell, J. (CSIRO) Kuiper, T. (JPL) Moran, J. (CfA) Jauncey, D. (CSIRO)	Imaging the nuclear H2O maser in NGC 3393. 1 cm
BL104	Lobanov, A. (MPIR, Bonn) Roland, J. (IAP, Paris) Ros, E. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Cross-band monitoring of a flare in the VLBI core of 3C345. 0.7, 1, 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. 2, 4, 6 cm
BL111	Lister, M. Aller, H. (Michigan) Aller, M. (Michigan) Cohen, M. (Caltech) 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: monitoring of jets in AGN with VLBA experiments. 2 cm
BL118	Loinard, L. (UNAM) Mioduszewski, A. Rodriguez, L. (UNAM)	Astrometric study of T Tau Sb. 4 cm
BL121	Lang, C. (Iowa) Bower, G. (Calif., Berkeley)	Search for emission from colliding wind binaries in Arches cluster. 3.6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BM191	Marscher, A. (Boston) Aller, M. (Michigan) Gomez, J. (IAA, Granada) Jorstad, S. (Boston) McHardy, I. (Southampton)	Relationship between X-ray events and superluminal ejections in blazar. .7 cm
BM208	Middelberg, E. (Middelberg) Krichbaum, T. (MPIR, Bonn) Roy, A. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Proper motions in NGC3079: infall, outflow or jet? 1,6 cm
BM213	Momjian, E. (Arecibo) Ghosh, T. (Arecibo) Salter, C. (Arecibo)	VLBA obs. of a possible phase calibrator for L-band Arp 220 obs. 20 cm
BN021	Nagar, N. (Arcetri) Falcke, H. (MPIR, Bonn) Maoz, D. (TelAviv) Wilson, A. (Maryland)	Accretion in low-luminosity AGN: A Radio, UV, and X-ray variability study. 6 cm
BN026	Neff, S. (NASA) Ulvestad, J.	VLBA Survey for AGN in galaxy mergers. 6 cm
BP109	Perlman, E. (Maryland) Landt, H. (STScI) Padovani, P. (STScI) Rector, T. (Univ. of Alaska) Stocke, J. (CASA)	Parsec scale structure of a new population of radio quasars. 6 cm
BP110	Petrov, L. (NVI) Fomalont, E. Gordon, D. (NASA) Kovalev, Y. Volvach, A. (CrAO)	VLBA Calibrator survey: Densification. 4,13 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BR092	Ratner, M. (CfA) Bartel, N. (York U.) Bietenholz, M. (York U.) Lebach, D. (CfA) Lederman, J. (York) Lestrade, J. (Paris Obs) Ransom, R. (York U.) Shapiro, I. (CfA)	Astrometry of HR 8703 in 2004. 2, 4, 6 cm
BS096	Suda, H. (Univ. of Tokyo) Honma, M. (NAOJ) Sasao, T. (NAOJ)	Phase referencing VLBA obs. of water maser source in the inner galaxy. 1 cm
BS133	Savolainen, T. (Tuorla) Bottcher, M. (Ohio Univ.) Raiteri, C. (Torino) Takalo, L. (Tuorla) Villata, M. (Torino) Wiik, K. (Tuorla)	Multi-frequency properties of the Blazar 3C 66A. 0.3,0.7, 1, 4, 6, 13 cm
BU027	Ulvestad, J. Neff, S. (NASA/GSFC) Teng, S. (Maryland)	Monitoring young supernovae in Arp 299. 3.6 cm
BV053	Vlemmings, W. (Cornell) Chatterjee, S. Diamond, P. (Manchester) van Langevelde, H. (JIVE)	Parallax and proper motions of late-type stars OH maser VLBA astrometry with in-beam calibrators. 20 cm
BW069	Wiik, K. (Tuorla) Raiteri, C. (Torino) Savolainen, T. (Tuorla) Takalo, L. (Tuorla) Villata, M. (Torino)	Multi-wavelength monitoring of a highly active blazar. 0.3, 0.7, 1, 2, 6, 13 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BW070	Walker, R.C. Wrobel, J. Ly, C. (Univ. of Arizona)	Imaging the jet base in FRI galaxy M84. 0.7 cm
BW072	Wiik, K. (Tuorla) Savolainen, T. (Tuorla) Tornikoski, M.(Metsahovi) Valtaoja, E. (Tuorla)	Multi-wavelength monitoring of an intraday variable blazar: BL Lac object 0716+714. .0.3, 0..7, 1, 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
GA019	Agudo, I. (IAA, Andalucia) Bach, U. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Bremer, M. (Bristol, UK) Grewing, M. (IRAM) Terasranta, H. (Helsinki) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Structural monitoring of jet in NRAO 150. 0.3 cm
GB049	Bartel, N. (York U.) Bietenholz, M. (York U.) Rupen, M. Beasley, A. (Caltech) Graham, D. (MPIR, Bonn) Altunin, V. (JPL) Venturi, T. (Bologna) Umana, G. (Bologna) Cannon, W. (York U.) Conway, J. (Chalmers, Onsala)	SN 1993J: center of the shell and its structural and spectral evolution. 6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
GB051	Bach, U. (MPIR, Bonn) Friedrichs, S. (MPIR, Bonn) Impellizzeri, C. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Polarimetric monitoring of IDV blazar 0716+714. 0.3 cm
GI001	Imai, H. (NFRA) Diamond, P. (Manchester)	Kinematics of expanding circumstellar envelope of W43A. 18 cm
GK023	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)	Structural monitoring of blaazr 1633+382 after major flare. 0.3 cm
GK024	Krichbaum, T. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Structural monitoring of the jet in M87. 0.3 cm
GK025	Klare, J. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Lobanov, A. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Zensus, J. (MPIR, Bonn) Witzel, A. (MPIR, Bonn)	Structural monitoring of jet in quasar 3C 345. 0.3 cm
GK029	Krips, M. (Cologne)	Parsec scale radio emission in the nuclei of nearby Seyfert and LINER galaxies. 6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
GM051	Mack, K. (NFRA) Snellen, I. (Royal Obs) Vermuelen, R. (NFRA) Schilizzi, R. (NFRA) Klockner, H. (Groningen/Kapteyn)	HI absorption observations of young radio sources. 18 cm
GM053	McHardy, I. (Southampton) Seymour, N. (Southampton) Uttley, P. (Southampton)	Imaging the narrow-line Seyfert 1 galaxy NGC 4051. 18 cm
GP040	Pagels, A. (MPIR, Bonn) Klare, J. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Structural monitoring of jet in quasar 3C 454.3. 0.3 cm
GS021	Snellen, I. (Royal Obs) Mack, K. (NFRA) Schilizzi, R. (NFRA)	Young radio sources at low redshift. 6 cm
GV017	Kanekar, N. (TIFR) Vermeulen, R. (NFRA) Chengalur, J. (TIFR) Ghosh, T. (NAIC)	OH absorption and emission at z~0.25 toward PKS 1413+135. 18 cm

Personnel

NEW HIRES

Abdullah, Joel	Electronics Engineer III	05/17/2004
DeBonis, David	Software Engineer I	04/05/2004
Dunlap, Colton	Junior Engineering Associate	05/17/2004
Duplain, Ronald	Junior Engineering Associate	06/22/2004
Duvall, Eugene	Electronics Engineer III	06/21/2004
*Hale, Andrew	Software Engineer III	06/21/2004
Harrington, Steven	Software Engineer III	06/09/2004
Holmes, Ernest	Electronics Engineer II	05/17/2004
Leyba-Newton, Laura	Electronics Engineer II	05/19/2004
Murowinski, Richard	Project Engineer	05/18/2004

TERMINATIONS

Bhatty, Azmat	Junior Engineering Associate	05/13/2004
Grichener, Alexander	Electronics Engineer III	05/27/2004
McCarney, Benjamin	Junior Engineering Associate	04/30/2004
Milner, Marily "Ruth"	Deputy Assistant Director	05/31/2004
Molina, Ramon	Supervisor, VLA Antenna	04/21/2004
Parker, David	Electronics Engineer I	04/30/2004
Sullivan, Mark	Senior Designer	06/07/2004
Uphoff, Jeffrey	Software Engineer I	04/30/2004
Vahle, Herald	Electronics Engineer III	04/29/2004
Verdugo, John	Software Engineer II	04/02/2004
Wells, Donald	Scientist	05/31/2004

PROMOTIONS

Shores, Kerry	Electronics Engineer III	06/01/2004

*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.

ABEL, N.P.; BROGAN, C.L.; FERLAND, G.J.; O'DELL, C.R.; SHAW, G.; TROLAND, T.H. Physical Conditions in Orion's Veil.

ANGLADA, G.; RODRIGUEZ, L.F.; OSORIO, M.; TORRELLES, J.M.; ESTALELLA, R.; BELTRAN, M.T.; HO, P.T.P. A Single Circumstellar Disk in the SVS 13 Close Binary System.

APPLETON, P.N.; FADDA, D.T.; MARLEAU, F.R.; FRAYER, D.T.; HELOU, G.; CONDON, J.J.; CHOI, P.I.; YAN, L.; LACY, M.; WILSON, G.; ARMUS, L.; CHAPMAN, S.C.; FANG, F.; HEINRICHSON, I.; IM, M.; JANNUZI, B.T.; STORRIE-LOMBARDI, L.J.; SHUPE, D.; SOIFER, B.T.; SQUIRES, G.; TEPLITZ, H.I. The Far- and Mid-Infrared/Radio Correlations in the Spitzer Extragalactic First Look Survey.

BERGER, E.; KULKARNI, S.R.; FRAIL, D.A. The Non-Relativistic Evolution of GRBs 980703 and 970508: Beaming-Independent Calorimetry.

BOBOLTZ, D.A.; CLAUSSEN, M.J. Ground-State SiO Maser Emission Toward Evolved Stars.

BOWER, G.C.; FALCKE, H.; HERRNSTEIN, R.M.; ZHAO, J.-H.; GOSS, W.M.; BACKER, D.C Detection of the Intrinsic Size of Sagittarius A* through Closure Amplitude Imaging.

CANNON, J.M.; SKILLMAN, E.D. The Nature of Radio Continuum Emission in the Dwarf Starburst Galaxy NGC 625.

CHANDRA, P.; RAY, A.; BHATNAGAR, S. The Late Time Radio Emission from SN 1993J at Meter Wavelengths.

CHOI, Y.Y.; REYNOLDS, C.S.; HEINZ, S.; ROSENBERG, J.L.; PERLMAN, E.S.; YANG, J. Observations of A4059 with Chandra, Hubble Space Telescope and the Very Large Array: Unraveling a Complex Cluster/Radio Galaxy Interaction.

CRENSHAW, D.M.; KRAEMER, S.B.; GABEL, J.R.; SCHMITT, H.R.; FILIPPENKO, A.V.; HO, L.C.; SHIELDS, J.C.; TURNER, T.J. High-Resolution Ultraviolet Spectra of the Dwarf Seyfert 1 Galaxy NGC 4395: Evidence for Intrinsic Absorption.

DARLING, J. A Laboratory for Constraining Cosmic Evolution of the Fine Structure Constant: Conjugate 18 cm OH Lines Toward PKS 1413+135 at z=0.2467.

DEMOREST, P.; RAMACHANDRAN, R.; BACKER, D.C.; RANSOM, S.M.; KASPI, V.; ARONS, J.; SPITKOVSKY, A. Orientations of Spin and Magnetic Dipole Axes of Pulsars in the J0737-3039 Binary Based on Polarimetry Observations at the Green Bank Telescope.

GALLIMORE, J.F.; BAUM, S.A.; O'DEA, C.P. The Parsec-scale Radio Structure of NGC 1068 and the Nature of the Nuclear Radio Source.

Publications

GONZALEZ DELGADO, R.M. ; CID FERNANDES, R.; PEREZ, E.; MARTINS, L.P.; STORCHI-BERGMANN, T.; SCHMITT, H.; HECKMAN, T.; LEITHERER, C. Stellar Populations of Low-Luminosity Active Galactic Nuclei. II. Space Telescope Imaging Spectrograph Observations.

GOTO, T. Are E+A Galaxies Dusty-Starbursts?: VLA 20cm Radio Continuum Observation.

GREENE, J.; LIM, J.; HO, P.T.P. Evidence for Interactions in H I Imaging of Seyfert Galaxies.

GROPPI, C.; KULESA, C.; WALKER, C.; MARTIN, C. Millimeter and Submillimeter Survey of the R Corona Australis Region.

HARDCASTLE, M.J.; HARRIS, D.E.; WORRALL, D.M.; BIRKINSHAW, M. The Origins of X-ray Emission from the Hotspots of FRII Radio Sources.

HEALY, K.R.; HESTER, J. J.; CLAUSSEN, M.J. A VLA Search for Water Masers in Six HII Regions: Tracers of Triggered Low-Mass Star Formation.

HERRNSTEIN, R.M.; ZHAO, J.-H.; BOWER, G.C.; GOSS, W.M. The Variability of Sagittarius A* at Centimeter Wavelengths.

HESSELS, J.W.T.; RANSOM, S.M.; STAIRS, I.H.; KASPI, V.M.; FREIRE, P.C.C.; BACKER, D.C.; LORIMER, D.R. A 20 cm Search for Pulsars in Globular Clusters with Arecibo and the GBT.

HOLLIS, J.M.; JEWELL, P.R.; LOVAS, F.J; REMIJAN, A.; MLLENDAL, H. GBT Detection of New Interstellar Aldehydes: Propenal and Propanal.

IYER, M.G.; SIMPSON, C.E.; GOTTESMAN, S.T.; MALPHRUS, B.K. Neutral Hydrogen in Arp 158.

JORSTAD, S.G.; MARSCHER, A.P.; LISTER, M.L.; STIRLING, A.M.; CAWTHORNE, T.J.; GOMEZ, J.-L.; GEAR, W.K. Change in Speed and Direction of the Jet near the Core in the Quasar 3C 279.

KAPLAN, D.L.; FRAIL, D.A.; GAENSLER, B.M.; GOTTHELF, E.V.; KULKARNI, S.R.; SLANE, P.O.; NECHITA, A. An X-ray Search for Compact Central Sources in Supernova Remnants I: SNRs G093.3+6.9, G315.4-2.3, G084.2+0.8, & G127.1+0.5.

KASPI, V.M.; RANSOM, S.M.; BACKER, D.C.; RAMACHANDRAN, R.; DEMOREST, P.; ARONS, J.; SPITKOVSKTY, A. Green Bank Telescope Observations of the Eclipse of Pulsar "A" in the Double Pulsar Binary PSR J0737-3039.

LEINERT, CH.; VAN BOEKEL, R.; WATERS, L.B.F.M.; CHESNEAU, O.; MALBET, F.; KOHLER, R.; JAFFE, W.; RATZKA, TH.; DUTREY, A.; PREIBISCH, TH.; GRASER, U.; BAKKER, E.; CHAGNON, G.; COTTON, W.D.; DOMINIK, C.; DULLEMOND,C.P.; GLAZENBORG-KLUTTIG, A.W.; GLINDEMANN, A.; HENNING, TH.; HOFMANN, K.-H.; DE JONG, J.; LENZEN, R.; LIGORI, S.; LOPEZ, B.; MEISNER, J.; MOREL, S.; PARESCE, F.; PEL, J.-W.; PERCHERON, I.; PERRIN, G.; PRZYGODDA, F.; RICHICHI, A.; SCHOLLER, M.; SCHULLER, P.; STECKLUM, B.; VAN DEN ANCKER, M.E.; VON DER LUHE, O.; WEIGELT, G. Mid-infrared Sizes of Circumstellar Disks around Herbig Ae/Be Stars Measured with MIDI on the VLTI *

Publications

MARRONE, D.P.; BATTAT, J.; BENSCH, F.; BLUNDELL, R.; DIAZ, M.; GIBSON, H.; HUNTER, T.; MELEDIN, D.; PAINE, S.; PAPA, D.C.; RADFORD, S.J.E.; SMITH, M.; TONG, E A Map of OMC-1 in CO J = 9 --> 8.

NEFF, S.G.; ULVESTAD, J.S.; TENG, S.H. A Supernova Factory in the Merger System Arp 299.

OSTEN, R.A.; BROWN, A.; AYRES, T.R.; DRAKE, S.A.; FRANCIOSINI, E.; PALLAVICINI, R.; TAGLIAFERRI, G.; STEWART, R.T.; SKINNER, S.L.; LINSKY, J.L. A Multi-Wavelength Perspective of Flares on HR 1099: Four Years of Coordinated Campaigns.

PARKER, D.H.; RADCLIFF, B.; SHELTON, J.W. Advances in Hydrostatic Leveling with the NPH6, and Suggestions for Further Enhancements.

PARKER, D.H.; SCHWAB, F.R.; SHELTON, J.W. Calibration and Modeling of a Dual-Axis Inclinometer.

PERRIN, G.; RIDGWAY, S.T.; MENNESSON, B.; COTTON, W.D.; WOILLEZ, J.; VERHOELST, T.; SCHULLER, P.; COUDE DU FORESTO, V.; TRAUB, W.A.; MILLAN-GABET, R.; LACASSE, M.G. Interferometric Observations of Mira Stars in Narrow Bands in the Near-Infrared, Unveiling the Star behind the Molecules.

RANSOM, S.; CAMILO, F.; KASPI, V.; SLANE, P.; GAENSLER, B.; GOTTHELF, E.; MURRAY, S. X-Ray Timing of the Young Pulsar in 3C 58.

RANSOM, S.M.; KASPI, V.M.; RAMACHANDRAN, R.; DEMOREST, P.; BACKER, D.C.; PFAHL, E.D.; GHIGO, F.D.; KAPLAN, D.L. Green Bank Telescope Measurement of the Systemic Velocity of the Double Pulsar Binary J0737-3039 and Implications for its Formation.

SEWILO, M.; WATSON, C.; ARAYA, E.; CHURCHWELL, E.; HOFNER, P.; KURTZ, S. Resolution of Distance Ambiguities of Inner Galaxy Massive Star Formation Regions II.

SHARMA, M.; MCNAMARA, B.R.; NULSEN, P.E.J.; OWERS, M.; WISE, M.W.; BLANTON, E.L.; SARAZIN, C.L.; OWEN, F.N.; DAVID, L.P. A Chandra X-ray Observation of Abell 1991: The Late Stages of Infall?

SHEPHERD, D. S.; BORDERS, T.; CLAUSSEN, M.; SHIRLEY, Y.; KURTZ, S. E. The Circumstellar Environment of the Early B Protostar G192.16-3.84 and the Discovery of a Low-Mass, Protostellar Core.

SODERBERG, A.M.; FRAIL, D.A.; WIERINGA, M.H. Constraints on Off-Axis Gamma-Ray Burst Jets in Type Ibc Supernovae From Late-Time Radio Observations.

STAGUHN, J.G.; SCHINNERER, E.; ECKART, A.; SCHARWACHTER, J. Resolving the Host Galaxy of the Nearby QSO I Zw 1 with Subarcsecond Multitransition Molecular Line Observations.

TAYLOR, G.B.; FRAIL, D.A.; BERGER, E.; KULKARNI, S.R. The Angular Size and Proper Motion of the Afterglow of GRB 030329.

TAYLOR, G.B.; PECK, A.B.; ULVESTAD, J.S.; O'DEA, C.P. Exploring the Nucleus of the Gigamaser Galaxy TXS 2226-184.

Publications

THUAN, T.X.; HIBBARD, J.E.; LEVRIER, F. The HI Kinematics and Distribution of Four Blue Compact Dwarf Galaxies.

VLEMMINGS, W.H.T.; CORDES, J.M.; CHATTERJEE, S. Separated at Birth: The Origin of the Pulsars B2020+28 and B2021+51 in the Cygnus Superbubble.

WANG, Q.D.; OWEN, F.; LEDLOW, M. X-raying Abell 2125 -- a Large-scale Hierarchical Complex of Galaxies and Hot Gas.

WILCOTS, E.M.; PRESCOTT, M.K.M. H I Observations of Barred Magellanic Spirals. II. The Frequency and Impact of Companions.

WILLIAMS, J.A.; DICKEL, H.R.; AUER, L.H. W49A North - Global or Local or No Collapse?

WROBEL, J.M.; GARRETT, M.A.; CONDON, J.J.; MORGANTI, R. VLBA Astrometry of Compact Radio Sources in the Spitzer First-Look Survey.

ZAPATA, L.A.; RODRIGUEZ, L.F.; KURTZ, S.E.; O'DELL, C.R. Compact Radio Sources in Orion: New Detections, Time Variability, and Objects in OMC-1S.

ZAVALA, R.T.; TAYLOR, G.B. A View through Faraday's Fog 2: Parsec Scale Rotation Measures in 40 AGN.