NATIONAL RADIO ASTRONOMY OBSERVATORY

Quarterly Report

July – September 2005

Cover Image: The First Prize image from the NRAO/AUI 2005 Image Contest.

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The ALMA Quarterly Report will be submitted separately to the NSF.

Executive Summary

NAASC

Progress was made on the development of a North American ALMA Operations Plan. Planning has begun for ALMA activities at the next two meetings of the AAS. Spectral line and calibration source catalogues have been specified, and implementation of the spectral line catalogue has started. A workshop on "Z-Machines" has been scheduled for early January 2006; other ALMA-related workshops are in the early planning stages. The ANASAC met once during this period.

EVLA

Testing and debugging of EVLA hardware and software on the two EVLA test antennas, Antennas 14 and 16, proceeded towards the goal of returning these antennas to routine operation. A few issues, related mainly to the robustness of the systems, remain to be solved before this goal can be achieved. The correlator passed its Preliminary Design Review without any significant technical issues. The overall correlator schedule has been delayed by six months compared to earlier estimates.

Green Bank Telescope

The Ka-Band (26-40GHz) receiver has been refurbished for full dual-beam, dual-polarization capability, and is ready to be reinstalled on the telescope in October. Construction of the Caltech Continuum Backend is complete, final lab testing with the receiver is underway, and commissioning will commence in December 2005.

The Penn Array bolometer camera underwent extensive testing in Green Bank. The dewar and all supporting electronics were successfully installed on the GBT, the dewar cooled, and the electronics controlled remotely through the software interface. The instrument passed stringent RFI checks. A usable bolometer array is expected early in the next quarter.

The GBT track refurbishment detailed design work is now complete, and the requests for proposals are out for quotation.

The 43m telescope has been brought back into operation, and has started satellite tracking tests for the MIT/Lincoln Labs bi-static radar project. The 45ft telescope is in routine operation tracking the sun as part of the Solar Radio Burst Spectrometer project

Very Large Array & Very Long Baseline Array

The VLA has been reduced to 23 operational antennas, with four antennas now in various stages of EVLA retrofits. EVLA antennas are expected to begin returning to the operational VLA in late 2005 or early 2006. A new VLA override process has been implemented to reduce reaction time to gamma-ray bursts, and has played an important role in identifying the first afterglows from the class of "short" bursts.

Executive Summary

Regular maintenance visits were made to the Los Alamos and North Liberty VLBA antennas; among other items, new digital tachometers were installed on the antennas. Mark 5 recording capability now is in place at nine VLBA stations, and the entire VLBA is expected to make the transition to full-time Mark 5 observing by early 2006. A data-base error that resulted in inaccurate Earth Orientation models being used for VLBA correlation has led to the production of a new off-line software tool to apply more accurate Earth Orientation values. This new tool will be crucial for the Mark 5 era, when the most accurate models are not available at the time of correlation, and also for any future real-time VLBI observations.

Central Development Laboratory

Prototypes of a 4-8 GHz amplifier and a redesigned 12-18 GHz amplifier, using NGST/JPL Cryo-3 wafer 200-μm wide devices and MAP 100-μm wide devices, have been successfully tested. Two more ALMA Band 6 wafers, delivered by UVA this quarter, were found to contain good mixers which complete SIS wafer production for Band 6. A detailed design of the S-Band feed was completed for the EVLA. Construction and testing of the first quadrant of the ALMA correlator was essentially completed, assembly of the second quadrant started, and the final 125-MHz clock distribution was installed and satisfactorily tested. The final two frequency sextuplers for ALMA Band 9 were delivered by VDI and evaluation is under way at the NTC. The second pre-production ALMA Band 3 warm cartridge assembly (WCA) was delivered to HIA and all four Band 7 laboratory test LOs were delivered to IRAM, along with the second pre-production WCA. A 70-300 MHz wide-bandwidth antenna is currently being fabricated for the Green Bank Solar Radio Burst Spectrometer and deployment is scheduled for December 2005. A data acquisition system and a frequency downconverter have been completed for a 100-ms sweep option over a 30-300 MHz band. A 300-2500 MHz downconverter is under development.

Computing and Information Services

Although this has been a tight year, we have managed to make some progress on modernizing our infrastructure. An upgraded email facility to reduce unwanted and unsolicited messages (spam) has been deployed. The installation of the enhanced NRAO intranet backbone at 20 Mbps was delayed last quarter, but it should be finally deployed in the coming quarter. A new Common Computing Environment project to co-ordinate the deployment of Apple Macs was started

Education and Public Outreach

Forty-one images were submitted by 21 individuals to the first annual NRAO / AUI Image Contest. First and second prizes, and seven honorable mentions, were awarded. EPO personnel presented three display papers and one educational workshop at the Astronomical Society of the Pacific's annual conference. A PBS Nova film crew visited the VLA to acquire footage for a program on black holes. Fifty-six students participated in a successful two-week West Virginia Governor's School for Mathematics and Science at Green Bank. The NRAO, White Sands Missile Range, and New Mexico Institute of Mining and Technology collaborated on multiple events to celebrate the 100th anniversary of

Executive Summary

Einstein's *annus mirabilis*. Three teachers participated in the 2005 NRAO Research Experiences for Teachers (RET) program. Compared to the same months in 2004, visitation at the VLA Visitor Center decreased by 9.0%; visitation at the Green Bank Science Center increased by 13.5% during the same period.

Environment, Safety, and Security

This quarter, the ALMA Safety program was initiated and policy development began to ensure safety requirements are followed within ALMA. In New Mexico, ES&S led the efforts to complete the annual National Fire Protection Association inspection and testing of the fire protection system for the VLA site. This quarter provided an opportunity to provide safety training to VLBA station technicians and two safety inspections were completed at VLBA sites. At Green Bank, the system checks for the CO2 fire suppression system at the 43m antenna were completed. The fire hydrants at Green Bank were checked/flow tested to ensure proper discharge. In Charlottesville, Fire Prevention and Fire Extinguisher training was provided at both the Edgemont Road and NTC facilities. During FY 2006, ES&S will be leading the effort to perform an Observatory-wide environmental audit to focus on compliance with environmental requirements.

Science Highlights

Very Large Array

VLA Reveals Centimeter-Sized Pebbles in Protoplanetary Disk - Multiwavelength VLA observations of the young star TW Hydrae revealed centimeter-wavelength emission from its dusty protoplanetary disk that indicates particles similar in size to the emission wavelengths. The formation of centimeter-sized particles is considered an important step on the path from dust particles to planets. The star's relatively close distance and its evolutionary stage are ideal for allowing study of the particles in its roughly 0.1-solar-mass dust disk.

Investigators: D Wilner (CfA), P. D'Alessio (UNAM), N. Calvet (CfA), M.J. Claussen (NRAO) and L. Hartmann (CfA).

Very Long Baseline Array

VLBA Measures Speed of Fastest-Moving Pulsar - Proper-motion and parallax measurements made with the VLBA have shown that the pulsar B1508+55 is moving at nearly 1100 kilometers per second and will inevitably escape the Galaxy. This is the first direct measurement of a neutron-star speed that exceeds 1,000 kilometers per second. The pulsar's path can be traced back from its current position to a birthplace in the Galactic plane near the Cygnus OB association. The high birth velocity of the neutron star constrains evolutionary scenarios, and is greater than that predicted by the latest computer modeling.

Investigators: S. Chatterjee (NRAO and CfA), W. Vlemmings (Jodrell Bank), W. Brisken (NRAO), J. Lazio (NRL), J. Cordes (Cornell). W.M. Goss (NRAO), S. Thorsett (UC Santa Cruz), E. Fomalont (NRAO), and A. Lyne and M. Kramer (Jodrell Bank).

Green Bank

Extremely large volumes (i.e. many tens of TB) of pulsar data for timing, searching, and other projects continue to be taken with the GBT and a variety of pulsar backends (including the Spectral Processor, the BCPM, GASP, CGSR2 and the Spigot). One amazing indicator of the GBTs impact in this field is the number of new globular cluster pulsars that the GBT has found: 55 and counting! In only three years, the GBT has discovered more globular cluster pulsars than any other radio telescope has discovered in its lifetime. The vast majority of these pulsars were uncovered using the incredibly sensitive S-Band receiver + Spigot combination. One of these new pulsars, Terzan5ad, seems to be the fastest millisecond pulsar yet discovered with a spin period of 1.39ms, finally beating the 23-yr old record set by Don Backer and company for PSR B1937+21. Ter5ad and other new GBT discoveries are beginning to put strong constraints on the Equation of State of matter at supra-nuclear densities.

Science Highlights

The following figure updates the GBT globular cluster pulsar discovery count, and includes several pulsars discovered in October 2005 .

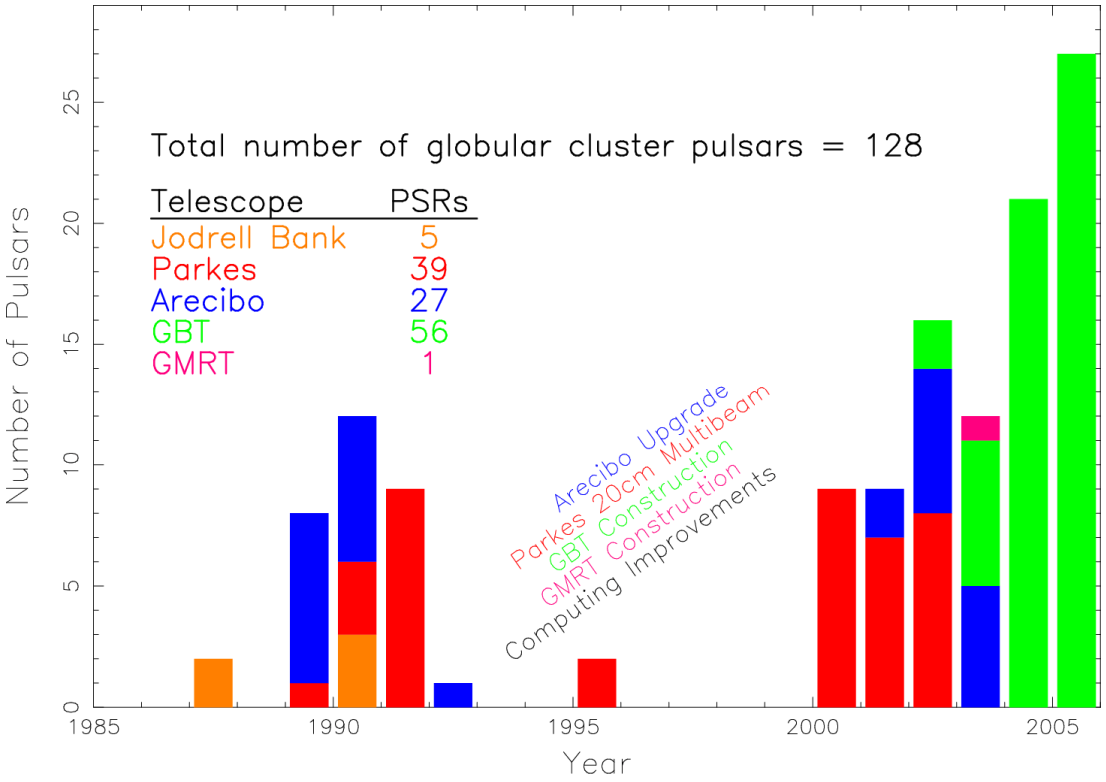

Figure 1. Plot of the GBT globular cluster pulsar (PSR) discoveries.

North American ALMA Science Center Highlights

Progress was made on the development of a North American ALMA Operations Plan. Planning has begun for ALMA activities at the next two meetings of the AAS. Spectral line and calibration source catalogues have been specified, and implementation of the spectral line catalogue has started. A workshop on "Z-Machines" has been scheduled for early January 2006; other ALMA-related workshops are in the early planning stages. The ANASAC met once during this period.

North American ALMA Science Center

Work on the NAASC staffing plan continued, with the NAASC staffing ramp-up reconciled with the expected ramp-down of the North American construction project, specifically for the engineering, computing, and science divisions. The staffing and budgetary impacts of the three scenarios requested by NSF for input into the Senior Review were evaluated. A document explaining the NAASC organization and staffing levels, and the effects of the various funding scenarios, was generated and used as the basis of the ALMA Operations section of the NRAO Program Plan for 2006.

The above exercise included some work on NAASC work breakdown structure (WBS), although we expect to revisit this exercise in the coming quarter pending receipt of a revised ALMA Operations Plan and budget from the Joint ALMA Office (JAO). As the re-baselining of the ALMA construction project nears completion, the implications of the re-baselining for operations will be incorporated into a revised Operations Plan and budget. We anticipate receiving this document next quarter and immediately revising the material provided the NSF Senior Review. Another review of the NAASC WBS will be required to eliminate any potential inconsistencies with the ALMA construction plan, with special attention paid to commissioning of antennas and the transition from construction to operations. Assuming that the JAO completes its Operations Plan and underlying WBS, our goal is to have a North American ALMA Operations Plan complete by the end of the calendar year.

The NAASC staff together with interested parties met every two weeks during this quarter to discuss progress. The status of each working group (leader shown in parentheses) is as follows:

Proposal Functions (E. Fomalont): The development of a tool for proposal submission for all NRAO telescopes, including ALMA, has been completed by a group in Socorro led by D. Frail. It has been thoroughly tested by many users outside the NRAO. It was used for proposal submission to the GBT at the June 2005 deadline and will be used for the VLA/VLBA at the February 2006 deadline. It will be used for ALMA as well and is known as Phase I of the ALMA proposal function software. Phase II is under development, mostly by European groups. It will take input from the Phase I tool to produce an observing schedule and the beginnings of a proposal database. The interface between Phase I and II is complicated and much more work is needed, but progress is being made on schedule.

NAASC

Science Functions (J. Hibbard): Test3 of pipeline data reduction, initially scheduled for October, has been deferred until December 2005. A Spectral Line Database Requirements document was generated and forwarded to the construction personnel who are developing the Proposal Submission Tool (PST). The plan is for a spectral line database to interface with the PST to help observers plan their observations. A molecular spectral-line expert, Andrew Markwick-Kemper, was contracted to work on the spectral line database and associated interface. He will also collect and standardize a mm calibrator catalogue with associated interface tools. By the end of this quarter spectral line and calibration source catalogues had been specified, and implementation of the spectral line catalogue had started. Andrew contacted other elements in the project to inform them of our plans. A face-to-face meeting is planned in November 2005 to help coordinate efforts between the NAASC, PST, and related computing efforts.

Community Functions (P. Vanden Bout): A workshop will be held on the topic "From Z-Machines to ALMA: (Sub)millimeter Spectroscopy of Galaxies", in Charlottesville, January 12-13, 2006. The scientific organizing committee has completed plans for the program. The local organizing committee has held regular meetings during this quarter and plans for the workshop are complete. More information can be found *http://zmachines.net*. Workshops being considered include joint workshops with the Herschel and James Webb Space Telescope missions. Articles were written for the October 1, 2005 NRAO Newsletter. The website was updated, with a link to the NAASC organization chart added.

The application filed with the American Astronomical Society (AAS) for a Town Meeting at the Washington, DC meeting of the Society, January 9-12, 2006, has been approved. The Town Meeting will take place immediately following the lunch break on the first day of the meeting. An initial agenda has been formulated and will be completed next quarter. The 2006 summer meeting of the AAS will be held in Calgary, Canada, with the first day a joint meeting with the Canadian Astronomical Society (CASCA). Planning has begun with colleagues in Canada for a special ALMA session on the overlap day.

The ALMA North American Science Advisory Committee (ANASAC) met once during this quarter, in a telecom on August 26. This focused on briefing the ANASAC on the rebaselining exercise and activities for the NSF Senior Review. The ANASAC reviewed the ASAC recommendations regarding rebaselining and drafted a letter to the NRAO director to emphasize the viewpoint of the North American community, reaffirming its strong support for the Project and urging NRAO to resist changes which would seriously compromise ALMA's science goals.

Expanded Very Large Array

Expanded Very Large Array (EVLA) Highlights

Testing and debugging of EVLA hardware and software on the two EVLA test antennas, Antennas 14 and 16, proceeded towards the goal of returning these antennas to routine operation. A few issues, related mainly to the robustness of the systems, remain to be solved before this goal can be achieved. The correlator passed its Preliminary Design Review without any significant technical issues. The overall correlator schedule has been delayed by 6 months compared to earlier estimates.

Expanded Very Large Array Milestones

Milestones	Original Date	Revised Date	Date Completed
New time synchronization reliability	02/15/05		07/08/05
L-Band feed pattern Measurements	07/11/05		07/11/05
Antsol solutions available to EVLA M&C system	07/11/05		07/11/05
Correlator PDR	07/13/05		07/13/05
4 IF's on Antenna 16 working	03/09/05	07/15/05	07/20/05
Fabricate NRAO Q-Band MMIC post amplifier	07/16/04	07/19/05	07/25/05
C-Band receiver installed on Antenna 16	05/06/05	07/14/05	07/28/05
L355 digital timing distributor assembled and tested	08/04/05		08/04/05
M302 ICD complete	08/15/05		08/15/05
75/328 MHz converter module ready for test antenna	10/24/03	07/08/05	08/16/05
D30x MIB software ready	05/20/05		08/16/05
Point VLA antennas & drive lobe rotators w/ interim Observation Executor	08/22/05		08/22/05
Pointing offsets available to EVLA M&C system	07/29/05		08/22/05
Modcomp independent format for archive records specified	08/01/05		08/22/05
Functional prototype M302 available	08/01/05		08/22/05
4 IF's on Antenna 14 working	09/13/04	07/22/05	08/25/05
New shielded room grounding plan	07/29/05		08/26/05
FY 2006 Budget Plan due	09/16/05		08/28/05
EVLA outfitting complete on Antenna 18	08/30/05		08/31/05
D30x ICD (revision E) ready for software	04/18/05	07/26/05	09/01/05

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
Proposal tool - VLA	09/01/05		09/01/05
VLA archive tool to interact w/ user database	08/01/05		09/15/05
Balance the EVLA bandpass to VLA	09/19/05		09/19/05
Review/evaluate ALMA 3-bit sampler	09/22/05		09/22/05
M301 hardware, ICD ready for software	05/27/05	07/22/05	09/23/05
Define electronics hardware alarm points for Operations monitoring	09/26/05		09/26/05
Hardware acceptance tests on Antenna 16 complete	07/27/05	10/05/05	
Antenna 16 turnover to Operations	07/28/05	10/07/05	
3-bit sampler proposal due from consultant	10/07/05		
MIB control band select switches on Antenna 16	10/21/04	10/12/05	
M301 module ready to install on antenna	06/08/05	10/12/05	
Hardware acceptance tests on Antenna 14 complete	08/30/05	10/12/05	
4/P converter w/M301 ready for use	10/14/05		
VLA antenna setup w/ Observation Executor	10/14/05		
Delivery of electronics for two EVLA antennas to CONACyT	10/14/05		
*Q-Band receiver installed on Antenna 16	10/15/05		
Specify extensions to EVLA script and obs2script	10/17/05		
Final severity list for module alarms	10/31/05		
Final version of antenna VOIP phone	10/31/05		
Requirements for final version of Observation Executor complete	07/14/05	10/31/05	
Final version of antenna VOIP phone	08/15/05	10/31/05	
New VLA correlator controller operational, controlled from Modcomps	08/30/05	10/31/05	
Move Antenna 17 into AAB – start EVLA outfitting	11/01/05		
M302 design complete w/ test fixture	11/07/05		
4 IF's on Antenna 13 working	11/10/05		
4 IF's on Antenna 13 working	03/31/05	11/10/05	
Hardware acceptance tests on Antenna 13 complete	09/28/05	11/10/05	
Implement electronics hardware alarms in the checker software	11/14/05		
WBS cost data update	11/18/05		

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
First correlator chip prototype delivered	11/28/05		
New VLA correlator controller controlled from EVLA M&C system	11/30/05		
Preliminary on-the-sky test plan completed	11/30/05		
Telcal component fundamentally finished	11/30/05		
Complete Part 2 hardware bench integration	03/03/03	12/01/05	
Check for interference and bandpass shapes: 8, 22 & 45 GHz – written report	03/15/04	12/01/05	
Receiver stability tests: 8, 22 and 45 GHz	12/19/03	12/01/05	
Agreement on common project software model	09/01/05	12/05/05	
Implement support for severity list in checker	12/05/05		
WBS schedule updated	12/09/05		
Report on Receiver stability, bandpass shapes, linearity of RF design	08/12/05	12/12/05	
Start transition mode observing	03/15/05	12/15/05	
4 IF's on Antenna 18 working	12/13/05		
Begin RFI tests of new correlator shielded room	12/15/05		
Train the VLA operators on electronics hardware alarms	12/15/05		
Assemble RFI shell of new correlator shielded room	12/15/05		
RTP data multicast from L352, w/ listener thread in interim Observation Executor	07/29/05	12/16/05	
L-Band receiver prototype electronics assembly completed	12/17/05		
L-Band dewar assembled & tested	09/23/05	01/06/06	
Two F317 modules w/ MIB tested and ready for software	09/08/04	01/13/06	
Front Ends CDR	05/05/05	02/16/06	

Management

The budget plan for Fiscal Year 2006 was prepared and issued. As part of the Program Management Office Initiatives, the NRAO fiscal division has implemented changes to the general ledger accounting scheme. As a result, the project was able to modify its Chart of Accounts adding the flexibility to track cost expenditures with increased resolution down to Level 4 in the WBS.

Expanded Very Large Array

Systems Integration

EVLA Antennas 14 and 16 are now functioning with four complete IFs, all utilizing the new digitizer design. These antennas are being used by the scientific and technical staff to evaluate the performance of the EVLA hardware and software. Current testing is focusing on the phase noise and amplitude stability of the electronics hardware in an attempt to determine the cause of a few tens of percent loss of expected sensitivity. We also now have sufficient modules to repopulate the test racks in the Array Operations Center (AOC) and are using them to evaluate performance as well.

We are continuing to make progress on outfitting the third and fourth EVLA antennas, Antennas 13 and 18, with EVLA hardware. Antenna 13 outfitting is essentially finished and is awaiting a complete set of tested modules to be installed in the racks. Racks will be installed in Antenna 18 in early October, leaving it in essentially the same state as Antenna 13 by mid-October. Some modules are ready for these antennas but we are currently concentrating on the testing of Antennas 14 and 16 and the test rack. We are awaiting the results of these tests to determine if modifications are necessary, as well as the completion of the remaining modules, before populating the racks in Antennas 13 and 18.

Civil Construction

Preparations are completed for the installation of the correlator shielded room. The contractor Universal Shielding is scheduled to begin erection of the new RFI Shielded Room in October 2005. Their tentative completion is early December 2005. At that time the room will be given an Integrity Test, checking for room tightness, which is required as part of the Fire Suppression contract. After the integrity test, the room will be tested for RFI leakage per the room specification. Fire suppression system RFQs were sent out and bids should be received by October 12, 2005. Preparation of RFQs for HVAC equipment, computer flooring, and power distribution equipment are underway and will be issued for bids by the end of October 2005. An additional RFQ for a 150 KVA power UPS will be issued by the middle of November 2005.

Antennas

The mechanical outfitting of the fourth antenna, Antenna 18, was completed. Preparations started for the next few EVLA antennas. The VLA Machine Shop lost two people by resignation. This caused some of the production fabrication to be outsourced at an increase in cost. To mitigate the cost the Green Bank Machine Shop agreed to provide help with the fabrication of key antenna and receiver components.

Front End

Antenna 16 modifications are progressing nicely. The racks and cabling have been installed. The C-Band receiver #2 has been installed and system sensitivity tests are in progress. The C-Band system temperature, which was initially observed as high was due to moisture in the feed. This has been remedied and further system tests are being performed; so far nominal parameters are being observed.

Also, the Q-Band interim receiver is fully assembled and is being subjected to laboratory test and checkout procedures prior to installation.

The K-Band and Q-Band receivers for Antenna 14 have been successfully upgraded, tested, and installed. Antenna 14 now has a full complement of receivers and is undergoing system tests. The P-Band receiver is awaiting the delivery of the M301 module to enable functional system testing.

The L-Band, X-Band, and K-Band receivers have been assembled, tested and delivered to the site for installation in Antenna 18. The electronic racks have been assembled and tested and will be installed in October 2005. Also, the fourth L-Band feed assembled to date has been installed on Antenna 18.

Two prototype FE card cages have been assembled and tested. The production units have been specified and are on order.

L-Band feeds #5 and #6 are complete and #7 is assembled and is currently being laminated. The C-Band horns #3 and #4 that have been installed on Antennas 16 and 18 use the new machined aluminum design as opposed to the laminated rings and bands process. The production quantity of the remaining C-Band components are on order.

Local Oscillator (LO)

Three L305s and one L350 were constructed with the new boards. An additional re-spin of these boards will be required to correct some minor mechanical problems. It was also learned that the 128 MHz synchronized output had higher than expected phase noise and cannot be used as the reference for the L302 synthesizers. The 128 MHz crystal oscillator will be used instead. We are still waiting for the production order from MITEQ before full production on the synthesizers can begin. The production build of the L354 driver modules has been completed. Orders for the parts to build modules for the next five antennas are being written. Production work on the power supply distribution boards and the wire harnesses are being farmed out to the VLBA site techs. The round trip phase system is now performing well and is expected to go into production in the first quarter of 2006.

Fiber Optics

The Digital Transmission System (DTS) modules are on production schedule and the preliminary Interface Control Document (ICD) has been implemented on Antennas 14 and 16. The Antenna 13 DTS modules are assembled and tested and will be installed shortly. Production for the Antenna 18 modules will start very soon.

Antenna 13 is completely finished and is having the fiber optic cable installed. Antenna 18 is nearly completely outfitted with fiber optic cable. Everything outside the vertex room is finished and the Ethernet switch has been mounted. The remainder of the fiber cables in the vertex room will be installed after the LO/FE racks are installed. The fiber infrastructure is proceeding well with 35 of the 72 pads

ready for an EVLA antenna. A production order was placed for the remaining Monitor and Control Bus (MCB) racks.

Intermediate Frequency System

The first 4P converter was installed on Antenna 14. This module is ready for full production. The UX converter first production units have been received. The T304/T305 downconverters have been delayed due to the circuit card assembly house. There have also been some problems with the interface between the T304 and T305 due to the RFI filtering requirements. This interface has been redesigned and new boards have been ordered. The first M301 has been assembled and is having software written for it. This module also has interface problems due to the same RFI filtering requirements.

Correlator

The EVLA correlator PDR (Preliminary Design Review) was held from July 11-13 in Penticton, Bristish Columbia. The review committee consisted of Mark McKinnon (chair, NRAO), Bryan Anderson (JBO, UK), Ray Escoffier (NRAO), Dick Ferris (ATNF), Rick Perley (NRAO), Mike Revnell (NRAO), and Ken Sowinski (NRAO). All of the major components of the correlator were reviewed and it passed successfully. There were some minor technical concerns and budgetary concerns, pointing out that we must be vigilant to ensure that costs and contingency are well managed to ensure successful project completion. Our budget is being helped somewhat by the rise of the Canadian dollar, and by the improvement and cost reduction of technology. Nevertheless, careful use of funds is required to successfully complete the project as planned. Now that a firm delivery date is known for the prototype correlator chips it is possible to provide a clearer estimate of the overall correlator schedule. This new schedule shows on-the-sky testing of the prototype correlator in April 2007 and final commissioning of the full correlator in November 2009. Both of these dates are delayed by 6-9 months compared to the original schedule. These dates could be delayed further if any unexpected redesign of the correlator chip or circuit boards is required.

During the quarter a manufacturer was selected for the fabrication of all printed circuit boards for the correlator.

Monitor and Control (M/C)

A commercial vendor has manufactured and delivered 174 EVLA Module Interface Boards (MIBs) of the new design. The boards were tested by the manufacturer, and more tests are being conducted by NRAO.

The T304 (Baseband Converter SPI Board) and T305 (Baseband Converter Interface Module) have been redesigned and tested. The M301 (Converter Interface) prototype has been tested, and handed over to the software department. Currently, revisions are being made to the design of the M301 module.

Expanded Very Large Array

Three additional F320 (Front End Transition) and six M304 (Slot ID Module) were built during the past quarter. The design of the M302 Utility module is completed and testing has been concluded. The software has been written and work is underway to design its installation onto an antenna.

Progress has been made on crucial elements of the EVLA Transition Software for control of the hybrid array. The interim Antsol/Telcal program whose purpose is to provide complex antenna gains and on-the-fly pointing offsets to the EVLA Monitor and Control System has been completed. Work is nearly done on software to automate the updating of the coefficients of the pointing model in the parameters database, with the data taken directly for the output of the pointing analysis software (PEEK). Similar software is being developed for updating baselines. A crude version of delay-finding software has been developed, which includes an estimate of bandwidth as a quality indicator. Agreement has been reached on what information will and will not be included in the archive record produced by the EVLA Monitor and Control system while the old VLA correlator is still in use. This specification of the hybrid array archive record format will allow development of the VLA Data Capture and Format (DCAF) software to begin in Q4 2005.

In August, the new VLA correlator controller, including the newly developed serial I/O board, was used during several days of continuous observing in a wide range of correlator modes. A first analysis of the data taken suggests a higher than expected noise; further analysis of the data is ongoing.

The development of software for use by the operators to control the hybrid array is proceeding at a good pace. An "array screen" has been developed that will be the primary portal or gateway to a large variety of monitor and control functions, including job submission, the raising of alarms and alerts by the system, and access to subsystem screens that allow problem diagnosis. The device browser, software that directly accesses EVLA antenna subsystems, has been significantly enhanced, and has received strong endorsements and praise from the electronics engineers.

Test and verification plans specifying the software needed to support testing of the prototype Station and Baseline boards for the WIDAR Correlator was produced in Q3 2005. The needed test software is being developed primarily by NRAO software engineers, and is on schedule. The prototype Baseline board, without sample correlator chips, is expected at the end of November 2005. All of the software handlers needed for the baseline board modules are complete, the software for communication between the handlers and the test software GUIs is complete, and the GUIs are on schedule for completion by the time the prototype board is delivered. A prototype Station board is not expected until early 2006.

Data Management

The Interferometry Software Division (ISD) continued work toward the development of common models between EVLA and ALMA. Work on the Science Data Model is in good shape, but progress on the Project Model was delayed because of ALMA commitments. We intend to make progress in this area in the fourth quarter of 2005, beginning with meetings to be held during the ADASS conference in early October.

Expanded Very Large Array

There has been intense recruitment activity for the two new e2e positions. This was further aggravated by the departure of two staff members in the division. Of those four open positions, we have filled one. This has further delayed work on a high level architecture; we are planning this now in late October once the new hire has come up to speed.

The new NRAO-wide proposal tool integrated with the also newly developed NRAO user database is currently being used for the October 3, 2005 GBT proposal deadline. It incorporates feedback received during the previous (June 2005) round of proposals. It also adds support for VLA proposal preparation; which is undergoing in-house testing during the current round. The tool will not be released for general VLA proposal use until the February 1, 2006 proposal round. Work is well underway for the VLA archive to use the same authentication for access to proprietary data as is in use for accessing proposals.

Green Bank Telescope

Green Bank Telescope (GBT) Highlights

The Ka-Band (26-40GHz) receiver has been refurbished for full dual-beam dual-polarization capability, and is ready to be reinstalled on the telescope in October. Construction of the Caltech Continuum Backend is complete, final lab testing with the receiver is underway, and commissioning will commence in December 2005.

The Penn Array bolometer camera underwent extensive testing in Green Bank. The dewar and all supporting electronics were successfully installed on the GBT, the dewar cooled, and the electronics controlled remotely through the software interface. The instrument passed stringent RFI checks. A usable bolometer array is expected early in the next quarter.

The GBT track refurbishment detailed design work is now complete, and the requests for proposals are out for quotation.

The 43m telescope has been brought back into operation, and has started satellite tracking tests for the MIT/Lincoln Labs bi-static radar project. The 45ft telescope is in routine operation tracking the sun as part of the Solar Radio Burst Spectrometer project.

GBT Milestones

GBT Antenna & Operations

Milestones	Original Date	Revised Date	Date Completed
Complete development of new rail concepts	12/31/03	08/01/05	08/01/05
Hold panel review meeting	01/31/04	12/07/04	12/07/04
Receive quotations and recommend awards	08/30/05	11/15/05	
Receive AUI/NSF approvals and make awards	10/30/05	12/30/05	

GBT Electronics

Milestones	Original Date	Revised Date	Date Completed
Spectrometer Upgrades			
LTA Test and Debug	04/15/05	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
GBT RFI Antenna Mount Design	10/29/04	01/01/06	
Test Building Receiver Handler	10/15/04	01/01/06	
EVLA X-Band Feed Towers (2)	10/31/05		
EVLA L-Band Feed Assemblies (3)	10/31/05		
EVLA K-Band Feed Towers (2)	09/30/05		09/28/05
GBT Walkway Repair	08/31/05		08/25/05

GBT Software & Computing

Milestones	Original Date	Revised Date	Date Completed
Integrate GFM/IDL; Deprecate IARDS	03/31/04	12/31/05	
Integrate Pulsar Modes into Astrid	12/31/05		
Eliminate Backlog of Software Maintenance Requests	12/31/05		

GBT Projects

Milestones	Original Date	Revised Date	Date Completed
PTCS			
Identify 1" level contributors to pointing error	09/30/04	project on hold	
Ready for prototype W-Band operation under benign conditions	10/01/04	project on hold	
Ease of Use			
Complete "Phase 4" of Observing API (near-earth objects, source catalogs)	06/30/05		
Data Handling			
Generate requirements for imaging	12/31/03	12/01/05	
First draft of GBT Science Data Model	03/31/05	12/31/05	
Ka-Band (1cm Rx)			
Develop LO Distribution Module	06/01/05	07/15/05	07/15/05
Refurbish Receiver	08/04/05		09/30/05
Install on GBT	10/03/05		

Green Bank Telescope

Milestones	Original Date	Revised Date	Date Completed
Penn Array Receiver			
Detectors Delivered to Penn	5/17/04	11/2005	
Full Lab integration at Penn	9/6/04	01/2006	
GBT Commissioning	2/21/05	02/2006	
3 mm Receiver			
Design/Fab Cryostat	11/10/05		
Final Receiver Assembled	02/01/06		
Caltech Continuum Backend			
Construction and lab testing complete	08/27/04	11/2005	
Commission on GBT	09/06/04	12/2005	

Azimuth Track

Development of the detailed design drawings for the new track components consumed most of this quarter. Both the drawings and specifications were submitted to our expert review panel in August, and their comments and suggestions were evaluated and incorporated where appropriate. The documents are now in the hands of NRAO's Procurement staff to finalize commercial terms and to obtain quotations. Following the quotations, the packages will be given to AUI and NSF for reviews and approvals. The team is focusing now on the aspects of installation, and will draw up specifications to support the drawings completed for this phase

Telescope Operations Activities

In addition to the design work on the azimuth track project, Telescope Operations completed the summer preventive maintenance (PM) activities. An inspection of the servomotor system motors showed that their conditions were much improved, thanks to PM measures undertaken last summer. This will be a future annual activity. A team of eight to nine painters worked through the summer on the GBT, making significant progress. A few painters were held over to address corrosion on the 43m telescope and its service tower as well. Inspection of work performed on the front walkway on Level 4 last summer revealed cracks in the welds had returned. Installed components were measured and incorporated into a finite element model by Art Symmes, NRAO's Senior Structural Engineer. The model was then run, using more accurate representations of the loads imposed on the walkway. Art then designed components to stiffen the walkway when it was in the tipped over position, and better distribute loads into the structure. The modifications were completed during the month of August by Telescope Operations Division and Mechanical Division employees. Regular checks will be made on this walkway. Re-commissioning of the 43m telescope continued, with most of the items for which Telescope Operations had responsibility being completed early in July. Operation of the telescope for tracking tests and to support the efforts of the Electronics Division was performed as needed. Daily use of the 45-foot telescope to observe the sun also began this quarter.

Green Bank Telescope

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 45ft and 43m Servo support, Spectrometer support and development, and the Caltech Continuum Backend project. Active surface maintenance also took a significant amount of time.

The 45ft servo system work for this quarter consisted of construction of the new servo system for the telescope. The new system will be installed this spring. The antenna is in daily operation with the old servo system providing motion.

The new motion control system for the 43m telescope was designed, built, and installed. Servo tuning and satellite tracking has been completed. Design work on the remote operations upgrade is underway.

During this quarter, spectrometer development concentrated on three areas: LTA card replacement, cross-correlation and spigot testing. The LTA replacement project continues firmware and hardware debugging. Cross-correlation testing concentrated on using the Cross-Correlation Test Fixture for engineering tests of the spectrometer's cross-correlation modes. We were able to demonstrate that eleven out of twelve modes worked as delivered. The twelfth worked after some tinkering with Xilinx personalities. Spigot mode testing consisted of looking for problems in the 2K, 4-bit spigot mode and concluded that it probably was not a problem in the hardware, rather in the decoding software. The spectrometer is in general fairly reliable although it occasionally produces bad data that is usually obvious. Thus trouble-shooting and repair accounted for only a small amount of the time spent on the spectrometer. About 2 FTE's are provided to the Spectrometer in either upgrade or repair mode.

The Digital Group is supplying engineering to assist the Caltech Continuum Backend project. We are designing all of the hardware, including the packaging design. About 4.5 FTE is assigned to this task. Other items that the Digital Group is involved in are GBT servo system support, repairing and maintaining printers, network cabling, and communications hardware on the GBT.

Microwave Group Activities

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

The 26-40 GHz receiver was removed from the telescope, and modifications to bring it up to its full complement of spectral channels and continuum detectors are completed. The receiver will be integrated with the Caltech Continuum Backend before being reinstalled in October.

The IF system received some attention this quarter as well. New IF amplifiers are being built and tested. Various module instabilities and failures were repaired, and investigations continue to improve gain stability with better temperature control and other steps, such as adding isolation amplifiers to the optical receiver module splitters.

The Microwave Group is supplying expertise to the 43m NRAO-MLL telescope project. The group is restoring, installing, and testing RF components at the telescope for use by the project. One of our S/X receivers was installed on the 43m and used for pointing and servo tests.

Development of a 68-92 GHz correlation receiver continues. Construction of the cardcage and waveguide test fixtures was completed. Design of an optical table providing thermal calibration standards and other selectable optical elements is complete, with some revisions necessary for manufacturing. Assembly of quartz vacuum windows with anti-reflection matching layers was completed, and the windows were tested and meet specifications.

A trial installation of the GBT/Penn Bolometer Array receiver and associated electronics was accomplished successfully. The cryostat was installed in the GBT receiver turret along with a RFI shielded rack of control and data acquisition electronics. The cryostat was successfully cooled to less than 300 millikelvin, and control functions exercised. Although there were no bolometer elements installed, the installation proved mechanical fit with the GBT.

RFI Management Activities

The RFI Group provides Observer Support, NRQZ Administration, and on-site and off-site RFI Mitigation.

In Q3, the NRQZ administrator processed 26 regular applications, and eight preliminary applications. ERPd restrictions were placed on one site. There were no site inspections. We filed objections with the FCC against two low power TV stations. However, objections were withdrawn after applications were amended to specify directional antennas.

Several problems with cable TV and power line RFI were identified and fixed. Wireless networks in the area are being identified and mitigated. Area businesses and schools have been advised against using wireless networks and received technical support regarding alternatives.

Anechoic Chamber testing included the Penn Array, the Cal Tech Continuum Backend, a screened box built by Rich Bradley, Long Wavelength Array (LWA) project (feed testing), and a replacement HVAC controller to be installed on the GBT. Our group is providing the mitigation solution

for the HVAC controller. SE testing was performed on the laser lab building and on the 43m telescope control room.

A one-antenna subset of the GBT RFI Monitoring station was installed and tested on the stand, and checks out. It has since been installed on the GBT, and will be tested as soon as the fiber links have been patched in. The full five-antenna installation requires a gimbal, which is being designed by the GB Mechanical Division.

We have obtained a surplus vehicle from the FCC that is equipped with a direction finding system that works up to 1 GHz. We have purchased equipment that will assist in locating and documenting the presence of wireless networks in the 2.4 GHz band.

We interviewed five candidates for the position of NRQZ administrator. One candidate was chosen and has accepted the position.

Our group gave presentations to several outside groups, including the Green Bank Elementary eighth graders, two groups from NRL, four groups of Governor's School students, DOD Spectrum Management personnel, and the Senior Staff of the Assistant Secretary of Commerce for Communications and Information.

Mechanical Engineering and Central Instrument Shop

This quarter the completion of the drawings and specifications for track work bid packages have been a major portion of the work done by the Mechanical Division working with the Operations Division. Using the information gathered over the past months drawings and specifications were prepared for bidding. In other work, the design for the Penn Array electronics crate and mount were check fit in an operational test of the Penn Array on the GBT.

In the third quarter, the Central Instrument Shop completed work on two EVLA K-Band feed towers and is continuing work on two X-Band feed towers. The Shop is also working on L-Band feed assemblies and C-Band dewar cans for the EVLA. These deliveries are part of a long term order which will stretch over the next several years. The Shop welders completed a project to repair and stiffen the Level 4 walkway on the GBT. Work also continues on the 3mm receiver and the shop continues to support the Lincoln Labs project on the 43m.

Software Development Division

The primary Software Development Division (SDD) accomplishments in Q3 2005 were: (a) a successful campaign that switched a large majority of visiting observers to Scheduling Block based observing using the Astronomer's Integrated Desktop (Astrid); (b) participation in the first test fitting of the Penn Array on the GBT; (c) the release of GBTIDL v1.1.1; (d) two releases of the control system software; and (e) participation in the NRAO/AUI NSF e2e Software Review.

Green Bank Telescope

Observing systems work focused on completing the transition to Astrid for visiting observers, which is a joint effort between the SDD and scientific staff. Several software items identified during staff astronomer evaluation of Astrid use were resolved this quarter to streamline the queueing interface for single Scheduling Block First-In-First-Out (FIFO) observing. The primary activity for the Data Handling project this quarter was releasing GBTIDL v1.1 on July 7 and 1.1.1 on August 16, containing bug fixes and minor enhancements requested during the initial period of use of the package. Plans for GBTIDL v1.2 and future versions of GBTIDL are currently being organized, geared towards a collaborative development model in which most of the additions will come from staff scientists and outside observers. The focus of maintenance activities this quarter was providing access for visiting observers to Spectrometer cross-polarization functionality and additions to the control system required for Astrid support.

The SDD produced two regular releases of its key product, M&C, with v5.5 on August 16, 2005, and v5.6 on October 5, 2005. In v5.5, most changes focused on preparing for the upcoming commissioning of the CCB and Ka-Band receiver planned for Q4. IF signal emulation for the Ka-Band receiver was enhanced to include a second beam and new calibration values measured by the Electronics Division and uploaded to a calibration database. Configuration was enhanced to allow observers to more finely setup the X-Band receiver. For v5.6, additional data samplers and hardware status samplers were added to the CCB Manager to support lab testing and future commissioning. Configuration was enhanced to provide access to cross-polarization in the Spectrometer. The antenna software was modified to support the introduction of source catalogs within Astrid.

Commissioning the Ka-Band Receiver, Caltech Continuum Backend, and Penn Array have been and will continue to be key priorities of the GBT over the upcoming months, and software work is underway for each of these efforts. After successful completion of the Penn Array testbed, the data archiver was completed and used for preparatory work for a test fit of the array on the GBT that occurred in August. Further enhancements to the data archiver are planned for next quarter. We plan to continue using the Penn Array testbed to prepare for commissioning activities scheduled for Q1 of next year. For the Caltech Continuum Backend, a manager to support engineering tests, which was released in M&C v5.4, was enhanced using engineering test feedback. Low-level support was provided for the Ka-Band receiver software.

Two major improvements to Astrid were added in Q3. The first was the introduction of predefined source catalogs, which are extensible by the observer. There are four major categoies of catalog supported: spherical, ephemeris, NNTLE, and conic. An observer may mix private (user-generated) catalogs with system catalogs or generate them on-the-fly within a scheduling block.

The user interface to Astrid underwent a major reorganization. The changes to the user interface were driven completely by user feedback from both staff scientists and visiting observers. The changes are focused on streamlining the scheduling block submission process and enhancing observation control.

In 2003, AUI submitted a proposal to renew their contract to operate the NRAO which was reviewed by an external panel in December of that year. The report provided by the review panel

included several important points on software, including a strong endorsement of both the e2e program and the restructuring of the software organization at NRAO into one more clearly representing the telescopes and projects. The panel report also recommended that the NSF hold a follow-up review of NRAO software and documentation. That review was held in September 2005 and was attended by representatives from the Software Development Division in Green Bank.

In total, the SDD delivered 89% and 88% of committed tasks respectively in Cycle-5 (C5) and C6; (88% and 91% of committed tasks were delivered in the previous two development cycles, C3 and C4). Performances is measured as the proportion of deliverables committed to, versus the total number of deliverables completed and approved by the task's sponsor by the end of the cycle.

To accomplish GBT goals, it was also noted in last quarter's report that the current SDD staffing vacancies must be filled, and adoption of technologies from other telescopes should be pursued. We are beginning the process of recruiting for the staffing vacancies. With regard to the adoption of other telescope technologies, we plan on starting a collaboration with the EVLA in the upcoming quarter to exchange ideas (and possibly design and/or code) on a software entity called the Scheduling Block Executor, which is responsible for running Scheduling Blocks. We have also been working with the AIPS++ group to determine how much of their code could be used at the GBT for data reduction. There is already progress in this area as were able to successfully import an AIPS++ library into GBTIDL with a small amount of effort.

Computing

Hardware

A few new workstations have been configured and deployed. A new SDLT tape library was also put in to service. This increases the backup capacity available and will allow us to start moving Windows users over to the netapp. Two new loaner laptops were purchased and are now available for use by traveling staff. These replace the aged sony vaio machines.

A new projector was also purchased for permanent installation in the conference room.

Software

The upgrade of Linux workstations to Red Hat Enterprise Linux has now started and is hoped to be complete by the end of next quarter.

Network

The Cisco 4507 in the equipment room is now fully commissioned and the Alcatel unit is shutdown. There have been no problems with the link between the telescope systems and the general computing networks since.

Green Bank Telescope

A new switch has been specified and ordered to replace the central Alcatel unit. It is hoped that this unit will be commissioned starting early in the 4th quarter of 2005. In preparation, additional fiber runs are being installed.

Additional laptop connections have been made available in the conference room.

Penn Array

Much of the third quarter was spent preparing for, executing, and following up from a fit check of the Penn Array on the GBT in the last two weeks of August. The final Penn Array dewar and all supporting electronics were successfully installed on the GBT, the dewar cooled, and the electronics controlled remotely through its software interface. The receiver and its electronics box also spent a week in the RFI chamber at Green Bank undergoing emissions testing; after a number of changes and improvements, the instrument met Green Bank's RFI mitigation requirements. A beta-version FITS archiver usable in NASA's IRC data acquisition program was produced at Green Bank, further development and testing of which awaits (re)delivery of a fully working set of warm MUX electronics to Green Bank. Goddard produced the final (8-column) series array and delivered it to Penn for installation to the cryostat. Detector development remained behind schedule but active, and a usable array has been promised early in Q4. NRAO also hired recent Oberlin graduate Phil Korngut on a one-year contract, who will continue to be stationed in Philadelphia assisting Penn with final dewar integration and testing until commissioning, after which he will come to Green Bank to assist with commissioning and documentation.

New Receivers and Backends

The Caltech Continuum Backend (CCB) was assembled and bench-tested this quarter, meeting all performance requirements. The YGOR manager was integrated with the Caltech software and extensively tested using both simulators the real hardware, acquiring data from the CCB from a variety of benchtop sources. The testing went remarkably smoothly, with basically no surprises, a tribute to excellently conceived and executed design on the part of the entire CCB team. The CCB was also connected to the 26-40 GHz receiver and seen to control the beam switches and calibration diodes, and acquire data from the receiver's RF detectors, in the expected manner. The 4th quarter should see detailed characterization of the integrated CCB/receiver noise performance in the lab, final RFI qualification, and purchasing of the final power supplies (which required lab testing to specify). We aim for first light on the GBT before the end of the year.

Spectrometer Upgrades and Pulsar Backends

In regard to the spectrometer upgrade, all cross-polarization modes have been tested in the engineering lab and are ready for astronomical tests in mid-October. Work on the LTA upgrade continues.

For the Spigot, significant improvements have been made to its usability. The Spigot is well on its way (beta-testing) to being able to be setup, calibrated, and run from Astrid. The two primary modes ("2" for 800 MHz bandwidth, and "42" for 50 MHz bandwidth) continue to be used for almost all science observations. The 4-bit modes still have known issues and work on resolving them is ongoing.

We have also begun looking into possibilities for a next-generation NRAO pulsar backend.

MIT/Lincoln Labs 43m Project

The major activity of the NRAO MIT-LL tracking station during this quarter was tuning of the 43m control system to assure accurate tracking of fast moving spacecraft. The pointing of the 43m system was tested by measurement of peak brightness of continuum radio sources. Offsets were found to be negligibly small, compared the Full-Width-At-Half-Maximum (FWHM) beam size of the telescope at the planned observing frequencies.

The interface file specification between MIT-LL and NRAO were updated, and the revised file formats were tested by exchange of; (1) Long Term Schedules; (2) spacecraft right ascension, declination files: and (3) tracking log files. Using the MIT-LL trajectory files provided, Wee successfully tracked the MSX spacecraft and recorded the the downlink telemetry signals. These tests confirm that tracking spacecraft at rates up to 20 degrees/minute may be reliably achieved.

The MIT-LL equipment trailer arrived on September 30, 2005 and was positioned at the 43m telescope, and wired for power. The MIT-LL equipment was powered up and the equipment passed the initial power-on testing.

Very Large Array and Very Long Baseline Array

Very Large Array (VLA) Highlights

Delays in electronic modules and acceptance of EVLA antennas for operations have led to a gradual reduction in operational VLA antennas; the number of operational antennas during the 3rd quarter of 2005 was reduced to 23 from the normal maximum of 27. The missing antennas are reflected in increased downtime reported in the VLA observing statistics. To prevent a further reduction in operational antennas, VLA antenna 12 was brought to the Antenna Assembly Building for a regular VLA overhaul rather than being modified for EVLA operations. We anticipate returning to EVLA overhauls in the 4th quarter of 2005 or early in the 1st quarter of 2006.

A new "advanced override" capability was implemented for an ongoing large proposal to study afterglows from gamma-ray bursts. At the beginning of each month, programs occupying 20% to 30% of the VLA observing time are identified as being eligible for overrides of up to 2-3 hours, without the time delays of an additional approval process through the chain of command. This new capability has contributed directly to the identification of afterglows from the "short" sub-class of gamma-ray bursts, and apparent confirmation that these events are the consequences of the mergers of two neutron stars.

Very Large Array and Very Long Baseline Array

Very Large Baseline Array (VLBA) Highlights

Regular VLBA maintenance visits ("tiger team" visits) were made to two VLBA antennas, Los Alamos and North Liberty. Routine preventive maintenance activities were undertaken as is customary on these visits. Both stations were converted from the old analog to digital tachometers for higher accuracy and reduced maintenance costs, leaving Mauna Kea as the sole VLBA antenna yet to undergo this upgrade.

All VLBA stations except St. Croix now have Mark 5 recording systems installed, and the VLBA correlator has nine Mark 5 playback units. By the end of the quarter, five VLBA stations were observing full time with Mark 5, while the others used tape part-time. As we are able to procure more disk modules for recording, we expect to convert all VLBA stations to full-time Mark 5 operation by early 2006.

A data-base error was discovered that led to the use of predicted values of Earth Orientation for correlation of VLBA observations between 2003 and 2005. This error resulted in some inaccuracies in the correlator model, leading to astrometric errors in uncorrected data. Modifications to the AIPS software were made to enable off-line application of the latest Earth Orientation values, often available only several weeks after observations are made. These modifications will permit the most accurate phase-referencing and astrometry when the Mark 5 installations enable reduced turnaround time. With Mark 5, many VLBA observations will be correlated before the most accurate Earth-orientation values are available.

Management and Scientific Milestones

Milestones	Original Date	Revised Date	Date Completed
Completion of Dwarf Galaxies Large VLA Project	09/26/05		04/30/05
VLA Dynamic Scheduling Trial	07/08/05		07/08/05
World Year of Physics VLA Tours	07/16/05		07/16/05
AIPS++ Stable Release 13	07/15/05		07/29/05
NRAO/AUI Input Submitted to NSF Senior Review	07/31/05		07/31/05
Global cm VLBI Session	08/04/05		08/04/05
Completion of Virgo HI Large Project on VLA	09/26/05		08/06/05
Trial Proposal Tool Released for VLA	05/01/05	09/01/05	09/01/05
VLA/VLBA Large Proposal Review Completed	09/16/05		09/09/05
VLBA Site Technician Workshop	09/16/05		09/15/05
AIPS++ Stable Release 14	09/15/05		09/22/05
Five VLBA Stations Full Time on Mark 5 Recording	09/30/05		09/30/05

Very Large Array and Very Long Baseline Array

Milestones	Original Date	Revised Date	Date Completed
VLA/VLBA Proposal Deadline	10/03/05		
VLA Public Tours	10/08/05		
Global mm VLBI Session	10/18/05		
Second Round of VLA Dynamic Scheduling Tests	10/31/05		
Global cm VLBI Session	11/10/05		
Decision on Outfitting VLA with 190 MHz Systems	08/05/05	11/15/05	
AIPS++ Stable Release 15	11/15/05		
AIPS 31DEC05 Frozen; 31DEC06 Released	12/31/05		
Seven VLBA Stations Full Time on Mark 5 Recording	12/31/05		
Full Proposal Tool Release for VLA	09/01/05	01/05/06	
AIPS++ Stable Release 16	01/15/06		
Completion of VLA Archive Imaging Pilot Project	01/31/06		
VLA/VLBA Proposal Deadline	02/01/06		
Global cm VLBI Session	03/09/06		
AIPS++ Stable Release 17	03/15/06		
Host International SKA Steering Committee Meeting	03/17/06		
VLBA Conversion to Full-Time Mark 5 Operations	03/31/06		
VLA/VLBA Proposal Deadline	06/01/06		
Retire VLA Modcomp Computers	03/31/06	06/30/06	

Computer Infrastructure Milestones

Milestones	Original Date	Revised Date	Date Completed
Expand archive to full capacity of 30TB from 17TB	08/31/05	07/15/05	07/30/05
Examine OS/X support (1)	09/30/04	07/30/05	08/15/05
Replace approx 80 older systems(3)	07/31/05	09/30/05	09/01/05
Develop NRAO/AOC Computing Infrastructure Long Range plan(2)	05/01/05	08/01/05	09/12/05
Bring up Antenna 18 EVLA MC network	10/15/05		
Upgrade AOC frame relay to 43Mbit	10/30/05		
Phase 1 of renumbering AOC IP address space	10/31/05		
Migration to Windows 2K domain(4)	07/31/05	12/31/05	
Upgrade all NRAO/NM Linux machines to Redhat Enterprise 4	12/31/05		

1) This has now become a CCE NRAO wide target.

2) Draft has been delivered to CV.

3) We were unable to meet the 80 systems target for budget reasons. Purchased systems were installed.
4) In progress, approximately 90% done.

Operations Software Support Milestones

Milestones	Original Date	Revised Date	Date Completed
Correlator controller operations by Modcomps	04/04/05	10/31/05	
Transcribe VLA observe/system files	11/30/02	01/01/06	
Correlator controller operational by EVLA Monitor and Control	04/04/05	03/31/06	
Translate and copy stored VLA monitor data form 9-track to DAT	03/01/04	06/30/06	

Electronics Milestones

Milestones	Original Date	Revised Date	Date Completed
Projects			
Performance Review of 190 MHz Prototype System	08/15/05		08/15/05
Install two 190 MHz Version 2 receivers on VLA antennas	10/15/05		
Third 190 MHz Internal Review Meeting	10/31/05		
Upgrade VLBA FRM System, Concept Test at PTVLBA	11/15/05		
Install at least twenty 190 MHz systems on the VLA	12/31/05		
Upgrade VLBA FRM System, Focus motor replacement installed at PTVLBA and evaluation complete	01/31/06		
Maser Maintenance			
Install Maser #2 at the VLA	08/01/05		08/01/05
Repair Maser #10 at the AOC	10/27/05		
Retrieve repaired Maser #1	11/11/05	06/15/06	
Receivers (FE)			
Replace the L-Band 20cm receiver at BRVLBA	09/15/05		08/31/05
Replace the P-Band 90cm receiver at HNVLBA	09/15/05		08/31/05
Replace the S-Band 13cm receiver at LAVLBA	10/26/05		
Replace the S-Band 13cm receiver at FDVLBA	10/26/05		
Replace the P-Band 90cm receiver at BRVLBA	10/31/05		

Very Large Array and Very Long Baseline Array

Milestones	Original Date	Revised Date	Date Completed
Improvements			
Upgrade the TAC and Servo Boards at LA	10/15/05		08/19/05
Upgrade the TAC and Servo Boards at NL	09/28/05		09/28/05
Upgrade the TAC and Servo Boards at MK	07/30/06		
VLBA			
Workshop for VLBA Site Technicians at AOC	08/09/05	09/15/05	09/15/05
Scheduled Maintenance Visit NLVLBA	09/28/05		09/28/05
Install new cable wrap at PTVLBA	10/31/05		
Install two additional Mark V Drives	11/23/05		
Place 20 additional Disk packs into service	11/23/05		
Evaluate the Contempo Dehumidification concept at BRVLBA and LAVLBA	12/30/05		
Scheduled Maintenance Visit SCVLBA	04/30/06		
Scheduled Maintenance Visit MKVLBA (ACU Upgrade)	07/30/06		
Scheduled Maintenance Visit HNVLBA (ACU Upgrade)	09/30/06		

Engineering Services Milestones

Milestones	Original Date	Revised Date	Date Completed
Antenna Group			
Complete C array reconfiguration	07/08/05		07/06/05
Los Alamos Maintenance Visit	08/06/05		08/06/05
Complete Antenna 18 Overhaul/Upgrade	08/22/05		08/22/05
North Liberty Maintenance Visit	09/30/05		09/27/05
Complete DnC array reconfiguration	10/14/05		
Complete Antenna 12 Overhaul (non EVLA)	11/16/05	10/20/05	
Complete D array reconfiguration	11/04/05		
Complete 26 Bearing Change	08/24/06		
Electrical Group			
A and B Array transformer PMs	07/05/05		07/06/05
Install VLA site power monitors	08/30/05		07/25/05
Fire Alarm LPS Overhaul	09/09/05		09/09/05
Rebuild spare VLBA encoder	08/30/05		09/15/05
C and D array transformer PMs	11/30/05		
Site & Wye Group			
National Crane Repair AC install	07/15/05		07/15/05
Tie Extractor Initial checkout/repair	07/22/05		08/15/05

Very Large Array and Very Long Baseline Array

Milestones	Original Date	Revised Date	Date Completed
Antenna Group			
Fire Truck Cylinder head replacement	07/22/05		08/30/05
Spike Driver Initial checkout/repair	08/05/05		09/05/05
Jackson Tamper Repair	08/30/05	11/30/05	
Surplus Vehicle (three trucks) initial checkout/repair	08/30/05	11/30/05	
Complete track repairs between BN6-AN5	12/31/02	11/30/05*	

*Lining and leveling pending Jackson Tamper repairs. North arm track is usable.

AIPS

Key Developments

1. Methods were developed in the last quarter of 2004 to allow for binary distribution of AIPS. In the first nine months of 2005, 43 sites downloaded the frozen 31DEC04 version and 221 sites downloaded the development 31DEC05 version of AIPS using this capability. So far, a total of 219 sites have downloaded 31DEC04, 676 sites have downloaded 31DEC05 and 801 sites have used the AIPS cvs code management facility. In all, 1216 different sites (different IP addresses) appear in one or more of these lists.

2. The binary version for Linux sites was changed to use the Intel compiler. The load modules are prepared in a form that optimizes performance for older and current Pentium IV cpus but also allows excellent performance on other computers such as AMDs. For the older Pentium IVs, the performance improvement is about 35%.

3. When VLBI data are correlated, an estimate of the location of the Earth's pole must be used. Some weeks later, a better measurement of the Earth's pole become available. Due to an error, rather poor estimates of the pole position were used over the past couple of years, but even with the best estimates, better information becomes available at a later time. The AIPS task CLCOR now has the option to use the later information to correct the estimates that were used during correlation. The data-reading task FITLD was also modified to put the pole position information in a more usable form for CLCOR.

4. Work on spectral index imaging has begun. A new task SPIXR was written to fit spectral index and curvature to a spectral cube. The task that builds cubes was modified to allow frequencies that are not regularly spaced to be made into a cube with the correct frequency information saved in a table. The image and UV data modeling tasks were modified to allow more model components and spectral-index variation in the components.

5. Other new tasks include one to copy calibration tables between polarizations and another to scale amplitudes in uv data. A service task to convert a public catalog (multi-user) installation into the now normal one user per catalog installation was written.

6. A new model for the primary flux calibrator 3C48 at 21 cm wavelength was released. The code that handles dynamic memory allocation in AIPS was revised to work almost always even on computers that use 64 bits for addressing. The automatic flagging task was corrected to flag data that fail to convert from baseline to antenna based forms; it now appears to eliminate most of the bad data. The tasks that image single-dish data were modified to handle data from the Green Bank Telescope. Numerous other improvements and bug fixes were also made during the quarter.

Goals for the Fourth Quarter 2005

1. Continue user support and bug fixes, as the major portion of AIPS effort.
2. Add to the task which computes the fluxes of the primary flux calibration sources new (2004) flux values and interpolation in time between the tabulated values.
3. Provide support for pipeline data reduction, especially new automatic editing algorithms.
4. Begin investigations of new/improved imaging algorithms, including those dealing with spectral index and multiple points.
5. Install modern world coordinate handling software to enhance and replace the original AIPS coordinate handling.

AIPS++

The key activities for this cycle were the development for the SS13-SS14 releases, development for the ALMA R3 release, preparatory work for the upcoming ALMA (single baseline commissioning) and EVLA (antenna pointing calibration), delivery of the monthly integrations of the Offline subsystem, and ongoing effort on the AIPS++ to CASA framework shift.

- SS13 *http://projectoffice.aips2.nrao.edu/ss13.html*
- SS14 Activity: *http://almasw.hq.eso.org/almasw/bin/view/OFFLINE/CurrentActivity*

Highlights:

- Initial framework implementation/migration (Python binding/interface to tool subset).
  - Initial user interface (CLI) implementation
- Initial fringe-fitting implementation
- Support for multiple data set inputs to imager tool
- Implementation/support for Calibration data model in ASDM
- Initial ASDM filler
  - DataCapture use of new ASDM framework
  - ASDM V3 document outline
- Initial Qt viewer (glish-less)

- General XY plotting facility (C++ based), initial.
  - Use of unified selection facilities in imager,msplot

Goals for the Fourth Quarter 2005

1. Initial, internal CASA deployment (subset of tools using iPython interface)
2. msplot (general XY plotting) reimplementation
3. MS averaging tool/support
4. Support for basic uv models in calibration
5. ALMATST4 deployment of web page for internal testing
6. ASDM Filler (all tables + binary)
7. Preparation for ALMATST4
8. ASDM V3 document
9. Mosaic benchmark improvements
10. EVLA imaging development (antenna pointing corrections, full beam polar.)

Archive

The NRAO Data Archive has now been operational since October 15, 2003 and allows everyone on-line access to all VLA data and some VLBA and GBT data (*http://archive.nrao.edu/archive*). To date, over 700 users from 250 institutions have downloaded over 4 Tbytes of telescope data (35,000 data files). The download data rate has climbed to about 200 Gbytes per month (1600 data files per month). Data files over one year old are in the public domain and accounted for over one-half of the download volume. The data files reside on a hard disk array and provide the archive users with fast access and downloads via FTP and HTTP.

Currently the archive contains all VLA data going back to 1976, raw VLBA data going back to August 1999, and some calibrated VLBA data going back to September 1993. Efforts to expand the VLBA archive back to 1992 are underway. GBT data from July 2002 through October 2004 are available.

During the third quarter of 2005, we registered six services with the National Virtual Observatory. The services are three image atlases and three radio source catalogs. There are now over 30,000 images from the NVSS, FIRST and VLBA 2cm surveys registered and available to Virtual Observatory (VO) users. The three radio source catalogs contain positions and flux densities of radio sources identified in the NVSS, FIRST and WENSS radio surveys. By the end of the year 2005, we expect to publish the CLASS radio survey in the VO registry.

Proposal Tool

The goal of this project is to create an NRAO-wide proposal submission tool. Though it has been designed from the start to make adding support for other telescopes in the future relatively straightforward, it initially has focused mainly on GBT proposal preparation and submission.

A second, equally important element of this effort is the NRAO user database, developed in parallel with the proposal tool. This user database is fully integrated with the proposal tool, and is used for authentication before access to a particular proposal is granted. Work is under way to use the same authentication to access proprietary data in the NRAO archive.

Following the successful first deployment of this tool for the June 1, 2005 GBT proposal deadline, we are currently in the middle of the second round of GBT proposal submission. In the meantime, we have fixed a number of bugs and incorporated comments from users. We also upgraded the hardware that is serving the various web-based applications.

We also added full support for preparation of VLA proposals. It was decided to go through one round of internal testing before releasing it for the February, 2006 deadline. For this test we have asked AOC-based scientific staff to submit their VLA proposals twice: first using the current method, and then using the new tool. We expect to incorporate the feedback and comments well in advance for the February 2006 deadline.

Virtual Observatory

NRAO is a partner is both the U.S. National Virtual Observatory (NVO) and in the International Virtual Observatory Alliance (IVOA). NRAO is active in VO development on three fronts: (1) participation in development of the international VO framework (e.g., IVOA data access and FITS standards development); (2) providing radio data and services to the VO; and (3) coordination of NRAO data management and science data post-processing development with the standards and technology being developed by the VO community.

The U.S. NVO project is starting the fifth and final year of the NSF ITR grant-funded phase of the project. The process of transitioning to the operational phase of the project, known as the NVO facility, is underway. Current plans call for joint NSF and NASA funding for a new national observatory, the NVO, which would operate in a distributed fashion with most staff resources located at the existing national observatories (including NRAO), major data centers, and national supercomputer centers. The operational NVO would operate some services on behalf of U.S. astronomy as well as provide ongoing development of international VO standards and infrastructure. An associated grants program is also planned.

Limited progress has thus far been made on implementing the NRAO VO plan due to lack of resources (the NRAO VO plan was drafted earlier this year and was released for discussion in April). Discussions within NRAO are in progress to try to identify resources in FY 2006 to accelerate implementation of the plan, in particular to support coordinated development with ALMA and NVO. The plans for development of the NRAO archive and VO interfaces were further developed as part of discussions held within NRAO in preparation for a review of NRAO software held at the NSF in late September. A preliminary agreement between ALMA, EVLA/VLBA, and ISD was reached regarding joint development of an NRAO-wide archive which would share common infrastructure with ALMA.

Very Large Array and Very Long Baseline Array

Meanwhile work on integrating image data into the NRAO archive continues. Simple image access (SIA) atlas image services were implemented for NVSS, FIRST, and the 2cmVLBA survey and were registered with the NVO in September. Acquisition of additional image collections is underway. Cone search services for the NVSS, FIRST, and WENSS catalogs, initially implemented a couple of years ago, were reimplemented within the current archive infrastructure and also entered into the NVO registry.

Work continues on the VLA "B" configuration archive imaging pilot project. An improved flagging algorithm has been developed for AIPS to help automate the pipeline processing. Production data processing has not yet begun.

The main focus for NVO development this past quarter involved the second NVO summer school, held at Aspen in early September. D.Tody represented NRAO on the faculty, giving a lecture on data access in the VO and a tutorial on client-side software development for the VO. The summer school was a high priority for NVO as it represented a critical early test of whether useful science can be done by the user community using NVO facilities. Considerable effort over the summer went into preparing a software release for the summer school. The proceedings of the 2005 NVO summer school are available online on the U.S.-VO web site (*http://www.us-vo.org*).

As part of the preparation for the NVO summer school, a Java library was prepared to support client-side data analysis with the VO. This library is first step towards development of a "VO-Client" facility for client data analysis with the VO, which will provide broader support for the VO infrastructure as well as integration with a number of popular client-side programming and scripting languages. Development of VO-Client will go forward into 2006 in cooperation with partners in Europe and the UK.

Work continues on a scalable data analysis framework for multi-wavelength data analysis integrated with the VO, as well as pipeline and offline data processing of data from NRAO and other observatories. A face-to-face meeting with our OPTICON (EU) partners was held at ESO in June, in connection with the inaugural Euro-VO workshop. A design for a general parameter mechanism was prepared for and discussed in this meeting. A second face-to-face meeting of the OPTICON/NVO working group was held at the end of September in conjunction with the ADASS conference in Madrid. A birds-of-a-feather session was also held at the ADASS to present the system architecture developed over the past year, as well as invite discussion from the broader community. The first phase of implementation of the framework is planned to go forward in 2006.

Updates were made to the Simple Spectral Access (SSA) protocol being developed for the IVOA. This was discussed at the fall IVOA interoperability meeting held immediately after the ADASS at ESAC outside Madrid. Completion of the V1.0 SSA interface has been delayed to the end of 2005 due to data model issues which still need to be resolved. Updates on plans for the V1.1 upgrade to the Simple Image Access (SIA) protocol were also presented. The first version of a new IVOA standard interface for access to spectral line databases was also presented.

J. Ulvestad and D. Tody attended an NVO science steering committee meeting held at Pittsburgh in July. D. Tody attended a follow-on NVO team meeting also held in Pittsburgh.

Very Large Array and Very Long Baseline Array

e2e Coordination

e2e is an NRAO-wide effort to develop a modern end-to-end dataflow system for all NRAO telescopes. This is primarily a coordination activity, with most actual development taking place within the telescope construction projects. e2e at NRAO is currently undergoing a transition, with many of the responsibilities of the e2e oversight and coordination committee we have had over the past year being folded directly into management of the individual projects.

A great deal of e2e-related discussion has taken place over the past quarter, mainly as preparation for a review of NRAO software held at the NSF in late September. A whitepaper prepared for the review presents an overall plan for e2e-related software development at NRAO. The whitepaper represents the consensus of all the telescope projects as well as the ISD (the science software groups and the archive/VO development effort), and relevant observatory management.

Other e2e-related work in the past quarter included a meeting held in Socorro in August to discuss the interferometric science data model (SDM) being developed for ALMA, EVLA, and VLBA (GBT SDM development is proceeding separately but is coordinated). The meeting included representatives from ALMA-Europe as well as NRAO-Charlottesville. F. Viallefond of ALMA-Europe gave a related invited talk on the common science data model at the ADASS in Madrid.

The issue of archive/VO development at NRAO, and how to proceed with this as a collaborative effort while telescope construction is also taking place, was discussed extensively during August. An updated plan for an NRAO-wide archive, including VO interfaces and integration of data from all NRAO telescopes including ALMA, was produced as part of the whitepaper prepared for the NSF review.

Central Development Laboratory

Central Development Laboratory Highlights

Prototypes of a 4-8 GHz amplifier and a redesigned 12-18 GHz amplifier, using NGST/JPL Cryo-3 wafer 200-μm wide devices and MAP 100-μm wide devices, have been successfully tested.

Two more ALMA Band 6 wafers, delivered by UVA this quarter, were found to contain good mixers which complete SIS wafer production for Band 6.

A detailed design of the S-band feed was completed for the EVLA.

Construction and testing of the first quadrant of the ALMA correlator was essentially completed, assembly of the second quadrant started, and the final 125 MHz clock distribution was installed and satisfactorily tested.

The final two frequency sextuplers for ALMA Band 9 were delivered by VDI and evaluation at the NTC is under way.

The second pre-production ALMA Band 3 WCA was delivered to HIA and all four Band 7 laboratory test LOs were delivered to IRAM, along with the second pre-production WCA.

A 70-300 MHz wide-bandwidth antenna is currently being fabricated for the Green Bank Solar Radio Burst Spectrometer. Deployment is scheduled for December 2005. A data acquisition system and a frequency downconverter have been completed for a 100-ms sweep option over a 30-300 MHz band. A 300-2500 MHz downconverter is under development.

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	ongoing	
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	04-01-06	

Central Development Laboratory

Milestone	Original Date	Revised Date	Date Completed
Electromagnetic Support:			
Design of EVLA Ku-Band feed	09-30-04	06-30-06	
Develop dual frequency 300/600 MHz feed for the GBT	09-30-05	03-31-06	
Study sidelobe characteristics of the GBT at 1400 MHz	09-30-05		09-30-05
Design EVLA S-Band feed	09-30-05		09-30-05
ALMA Correlator:			
Support system testing at the AOC as far as the correlator is concerned	03-31-04	ongoing	
Continue to receive and test production circuit cards	09-30-04	ongoing	
Finish motherboard PCB layout of a modified SCC test fixture	12-31-04	11-30-05	
Complete signal cabling of the correlator first quadrant	09-30-05		07-29-05
Implement and test cable timing training software	09-30-05	12-30-05	
Install final system clock distribution card	09-30-05		08-31-05
Started assembly of the second quadrant	09-30-05	12-30-05	09-15-05
Complete test cable timing training software effort	12-30-05		
Complete at least 1/4 of initial rack construction of the second quadrant	12-30-05		
Complete testing of the prototype TFB card in the system	12-30-05		
GB/SRBS Phase II:			
70-300 MHz, dual polarization, log-periodic on 45-foot telescope, new analog spectrometer	03-31-05	12-15-05	
GB/SRBS Phase III:			
10-80 MHz, dual polarization, four crossed dipoles, new digital spectrometer	09-30-05	06-30-06	
80-300 MHz, dual polarization, log-periodic on 45-foot telescope, new digital spectrometer	09-30-05	06-30-06	
300-2500 MHz, dual polarization, 45-foot telescope with log-periodic feed, new digital spectrometer	09-30-05	06-30-06	

Amplifier Design and Development

The development of a 4-8 GHz amplifier using NGST/JPL Cryo-3 wafer 200-μm wide devices and MAP 100-μm wide devices has been completed and the prototype successfully tested. A redesigned 12-18 GHz amplifier using the same devices has also been manufactured and a prototype tested. An effort to redesign the 40-50 GHz amplifier to achieve flatter noise and gain has commenced.

Central Development Laboratory

Amplifier Production

The production of amplifiers continued. Four L-Band high-power amplifiers, three 4-8 GHz low-noise amplifiers, four K-Band amplifiers and one Q-Band amplifier have been manufactured and tested. Also, three 12-18 GHz amplifiers, and two 4-12 GHz amplifiers have been rebuilt and tested.

Other Projects

A total of 27 L- and Q-Band LNA chassis received from the machine shop were inspected, prepared, and gold-plated. The Chem Lab has continued to meet all gold-plating needs, completing approximately 75 grams of gold-plating during the quarter at an estimated cost savings in excess of $10,000.

Superconducting Millimeter-Wave Mixer Development

SIS wafer production: Two more Band 6 wafers were delivered by UVA this quarter and found to contain good mixers. That completes SIS wafer production for Band 6.

Band 6 sideband-separating mixer-preamps: During this quarter, eleven mixer-preamps were assembled and tested. Some of these tests were for evaluation of the last two wafers from UVA.

There were some delays in dicing mixer chips this quarter when the dicing saw unexpectedly shut down. This was caused by transient pressure drops in the building water supply. We have constructed a pressurized storage tank to protect against such transients in the future.

Band 6 4-12 GHz preamplifier production: An order was placed with ACC for an additional 24 IF preamps. This will enlarge the pool of preamps and make it easier to find well gain-matched and phase-matched pairs for the sideband-separating mixers.

JPL has now delivered the 800 devices required to build all IF preamps for Band 6.

Band 6 cartridges: Mixer-preamps installed in cartridges #1 and #2 had good noise temperatures but did not quite meet the ALMA image rejection specification (IR ≥ 10 dB) at a few isolated frequencies (IR ~ 9 dB). These mixer-preamps are being replaced.

In two cartridges, we have found that, at several isolated LO frequencies near the low end of the band, there is insufficient LO power to pump the mixers at their optimum level. We plan to reduce the loss of the stainless-steel waveguide between the LO tripler and mixer by plating inside a segment of the waveguide. The power shortage will apparently be eliminated when more powerful GaAs power amplifiers are available to replace the short-lived InP power devices - this was demonstrated by preliminary measurements using a prototype GaAs amplifier.

Central Development Laboratory

Gain stability measurements of the Band 6 cartridge meet ALMA specifications when the initial version of the mixer bias supply is used. With a newer version of the bias supply, the gain stability slightly exceeds specifications at 0.1 second integration time. This is being investigated.

Cartridge #3 was assembled during the quarter but awaits mixers.

We have received 23 room-temperature IF amplifiers from AML. These have been tested and inspected.

The epoxy-filled windows for the WR-10 LO waveguide in the Band 6 cartridge have leak rates $< 2 \times 10^{-7}$ atm.cc/sec. Eight windows have been pressure-tested at 4 atm; the only failure was one which had been mechanically damaged during earlier tests. The waveguide vacuum window is described in ALMA Memo 536.

Band 6 cartridge test system: Last quarter, we reported finding a sidelobe at the -15 dB level when cartridges were measured in either the cartridge test system or the RAL cryostat. It appears that the sidelobe is caused by interaction between the infrared filters and vacuum window (not technically part of the cartridge). A cartridge frame with feed horn and mirrors was sent to IRAM for beam measurements at room temperature, but they were unable to see the sidelobe. Further tests are planned at the NTC.

Power supplies to bias the Warm Cartridge Assembly (WCA) were constructed and incorporated into the test system.

Automatic liquid nitrogen fill systems have been added to both the cartridge test system and the mixer test system. It is hoped that this will eventually allow unattended measurements overnight.

Band 3 and Band 6 OMT development: Two Band 6 and two Band 3 OMTs are partly assembled. Wire tensioning jigs have been constructed for installing the polarizing wires in the OMTs.

LO power amplifiers (all ALMA bands): The Northrop Grumman Space Technology (NGST) GaAs wafer run has been delayed by the foundry. However, the final design review of the mask set was held at NGST on October 11, 2005 and processing of the wafer should begin shortly. We have been assured that diced and spread wafers will be delivered by mid-January 2006. This wafer carries new designs for Bands 4, 8, two Band 9 options, and an already proven design for Band 6 that can deliver more power than the InP amplifiers currently in use. Several new power amplifier bodies have been designed and are being fabricated for these chips.

Central Development Laboratory

Non-ALMA Millimeter-Wave Development

350-μm receiver technology development: As NSF has now approved this project, the University of Virginia Microfabrication Laboratory has started developing a process to produce high-quality NbTiN films.

There are two important reasons for undertaking this work: (i) success in this project will put NRAO in a strong position to bid on the ALMA Band 10 receiver production; and (ii) this project will provide bridging funds to keep millimeter-wave receiver development alive at NRAO and UVA between the end of the ALMA development phase and the beginning of its operations phase in about three years when there is expected to be funding available to support further receiver development.

385-500 GHz SIS mixer: This is a joint project between NRAO and the University of Virginia Microfabrication Laboratory (UVML) and is supported mainly by UVA through an NSF grant. In this quarter, optimization of the junction fabrication process continued at UVML. Work on the design of the mixer block also continued, but progress is severely hampered by the lack of resources (time). A new technique for attaching the IF/DC beam lead of the mixer chip to the external circuit has been proposed and initial simulation shows that is practical. This new type of connection will be used in this mixer and probably also in the future 350-μm mixer.

Miscellaneous

NRAO Community Open House: Substantial time has been spent this quarter designing posters and displays for the NRAO Open House in October.

Investigation of Beam Lead HEB Mixers for Heterodyne THz Biohazard Detection

This began as a SGER (Small Grant for Exploratory Research) awarded by the NSF under the ACT (Approaches to Combat Terrorism) program. This was a one-year program to build, measure, and compare different types of beam lead HEB mixers in a 600-720 GHz receiver using existing NRAO equipment.

A Research Experiences for Undergraduates (REU) student spent the summer making more extensive measurements of the phonon-cooled HEB (pHEB) mixer on thin 3 μm Si, as well as improving the measurement setup. Using a prototype ALMA 4-12 GHz IF LNA, he measured noise temperature as a function of IF from 1-10 GHz (results are plotted in Figure 1) and determined that the 3 dB noise bandwidth for these mixers is about 7 GHz. These results were presented at the IRMMW-THz Symposium in September. We will also be collaborating with Prof. Robert Weikle (UVA) to measure the IF characteristics of a diffusion-cooled HEB mixer.

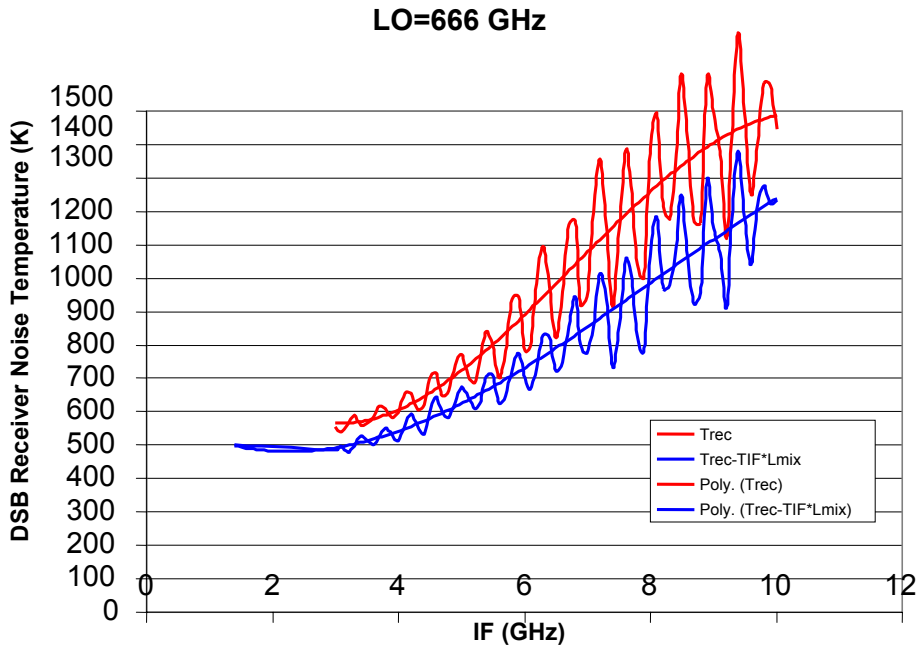

Figure 1. Measured DSB receiver noise temperature for the pHEB mixer with a 5% beamsplitter for LO injection. The red trace is the uncorrected receiver noise temperature. The blue trace has the noise of the IF chain removed. Both traces also have superimposed a polynomial fit to remove the effect of the mixer-LNA mismatch.

Electromagnetic Support

EVLA

A detailed design of the S-Band feed was completed. This feed design was based on a scaled version of the C-Band feed. However, design layout of the feed revealed a very tight fit on the feed cone. A new feed was developed, smaller in diameter by 2", but with about the same illumination taper as the original design. The new feed is 130" long and has an aperture inside diameter of 42". The average illumination taper at the edge of the subreflector is -13 dB.

A memo describing the design, prototyping and measurement of the C-Band feed was completed (reference EVLA Memo #95).

A full length paper titled "Efficiency at L-Band on the Expanded Very Large Array Synthesis Telescope" was submitted to the URSI-GA Conference, New Delhi, India.

Central Development Laboratory

Spectrometers/Correlators

ALMA Correlator

Construction and testing of the first quadrant of the ALMA correlator was essentially completed during this quarter. Only minor non-critical tasks remain to be finished.

The final 125 MHz clock distribution was installed and satisfactorily tested in August.

Software for rack-to-rack cable timing was developed and tested, but this effort is not yet completed. All cable runs tested error-free during weekend tests, but software needed to extract and install final timing parameters is incomplete.

Over 300 assembled production circuit cards of various types for the correlator were received. Most were tested and put in stock.

Testing of the tunable filter card prototype in the first quadrant of the correlator was begun and is progressing.

The only problem encountered during the assembly of this first quadrant was the discovery that one code date of the custom correlator chips used in the correlator seems to have a high failure rate. The extent of this problem has not yet been determined.

Assembly of the second quadrant of the ALMA correlator was started in September.

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 investigation of the requirement of frequency multipliers for the recently added Bands 4 and 8.

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) had been awarded the contract to supply the frequency triplers to meet the full ALMA first LO requirement (all 64 antennae, plus 10% spare units).

All of the units ordered for Band 6 and Band 7 (139 each) have been completed, tested and delivered by VDI. Subsequently, these have been accepted based on cryogenic evaluation of randomly selected units (two units were evaluated per batch of about 13 units) at the NTC.

The units that were evaluated as part of the acceptance testing have been made available for use in the receiver cartridges, while the remaining units are undergoing cryogenic evaluation in the laboratory prior to being made available for use. This evaluation work continued in this quarter, along with developmental work for the Band 4, Band 8, and Band 9 frequency multipliers (described below).

Band 9: As described in earlier reports, two frequency sextuplers were assembled and delivered to the Band 9 cartridge group after cryogenic evaluation for integration into the first cartridge. VDI has subsequently assembled and delivered another pair of similar frequency sextuplers which form the final deliverables for their current development contract. Work is under way at the NTC to evaluate these recently delivered units.

Alternative approaches: As described in the previous report, several alternatives (including the three varactor frequency doubler cascade based on the JPL Herschel design, relocating the power amplifiers inside the cold cartridge, power-combining existing amplifiers, etc.) were investigated. Four approaches were selected based on the criteria of minimum cost and schedule impact on the project. The following paragraphs provide an update of the status presented in the previous quarterly report. The dates provided for the scheduled completion of each approach are only indicative and should not be construed as a milestone.

1. Reverting back to the frequency quintupler: This option was being pursued during the last quarter, but is no longer considered a viable option owing to the lifetime issues with the InP-based HEMT power amplifiers[1]. Those power amplifiers are still on an existing wafer run and will be available for use if required (wafer fabrication completion date has been delayed by HRL).

2. An alternate drive source for the frequency quintupler could be a WR6.3×2 frequency doubler from VDI which could be pumped at a 200 mW level (inside the dewar) by a power amplifier (new design) producing 300 mW in the 61–71.2 GHz in the warm cartridge assembly (outside the dewar). The power amplifier should be available sometime in January 2006 (this was originally scheduled to be available sooner, but the wafer fabrication completion date was delayed by NGST). Evaluation results of the amplifier itself, as well as the overall performance of the frequency doubler-quintupler chain driven by this amplifier, shall be available soon thereafter. In the meantime, measurements were made to evaluate the performance of the proposed x2x5 chain by using the high-power source (adjusted to appropriate levels). The results from this measurement are shown in Figure 2 and provide a validation of this configuration.

[1] This was based on the conclusions of the "Interim Report on the Accelerated Life Time (ALT) Testing of the ALMA First LO Power Amplifiers (PA) MMICs," based on the work carried out at NRAO. A copy of this report is available at *http://edm.alma.cl/forums/alma/dispatch.cgi/iptfedocs/docProfile/101630/*

3. The possibility of power-combining four chips per polarization/channel was followed up to achieve increased drive power level for the existing integrated frequency sextupler. Such a block was fabricated, and a power amplifier assembled and debugged in this quarter (for use in the second first LO driver assembly for Band 9). This assembly is currently being used for evaluating the two Band 9 frequency sextuplers received from VDI recently, as described earlier in this report. However, this would be only an interim solution owing to the lifetime issue of the InP-based HEMT power amplifiers mentioned in Item 1, above.

4. Two-frequency tripler cascade option: Without changing the drive requirements for the final tripler stage in the frequency sextupler, this approach would lower the required input frequency range where increased drive power could be achieved using GaAs HEMT-based power amplifiers. These power amplifiers would need to be in the 67.8–79.1 GHz frequency which is very close to that of Band 4 first LO driver output. This variation of power amplifiers was designed and included on a wafer run and should be available for evaluation sometime in January 2006 (this was originally scheduled to be available sooner, but the wafer fabrication completion date was delayed by NGST).

   Existing frequency tripler data suggest that the efficiency loss in going from a frequency doubler to a frequency tripler would negate the benefit of improved input drive power. Consequently, such an approach could only be considered if the final frequency tripler were to be redesigned using reduced-height barrier diodes. Such a device became available this quarter. A commercial chip (Velocium APH481) which has commensurate power over most of the desired band was procured and is being assembled into a power amplifier block. This power amplifier block will be used, in the next quarter, to evaluate the feasibility of a ×3×3 cascade.

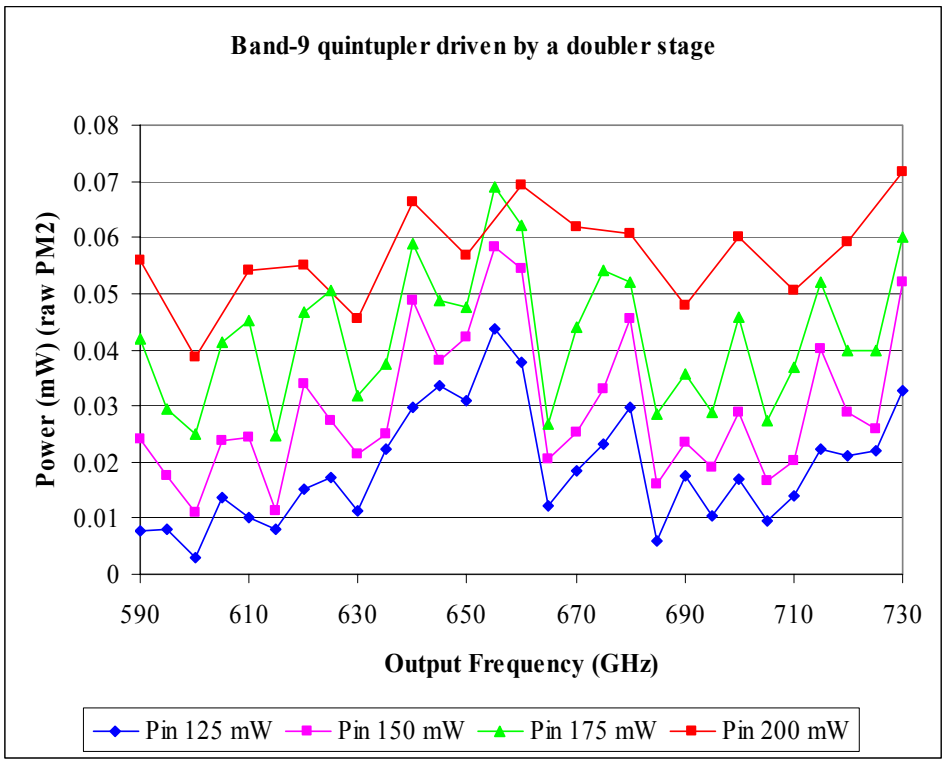

Figure 2. Performance of the Band 9 frequency quintupler driven by a frequency doubler stage. This measurement was made at room temperature.

An investigation into the procurement of frequency multipliers for the Japanese bands was initiated in this quarter. A brief summary of the status is given in the following paragraphs:

Band 4: The requirement is to be able to provide 250 μW over the 133.0–155.0 GHz (inclusive) range. An existing VDI WR6×2 design was identified as being able to meet this requirement with about 20 mW drive level in the 66.5–77.5 GHz range and is in the process of being procured.

Band 8: The goal for this band is 100 μW over the 393.0–492.0 GHz (inclusive) range. A prototype frequency quintupler was identified, but it did not meet specifications at room temperature. Nevertheless, measurements were performed on the unit at cryogenic temperatures over a portion of the desired frequency band (using a pre-prototype Band 4/8 hybrid driver assembly), and the results are summarized in Figures 3 and 4. These results appear to be quite encouraging. Further work will continue this quarter to ensure the survivability of these frequency quintuplers with about 50 mW input drive power to produce the desired 100 μW output LO power. If successful, they should be procured in a similar manner as the Band-4 frequency doubler.

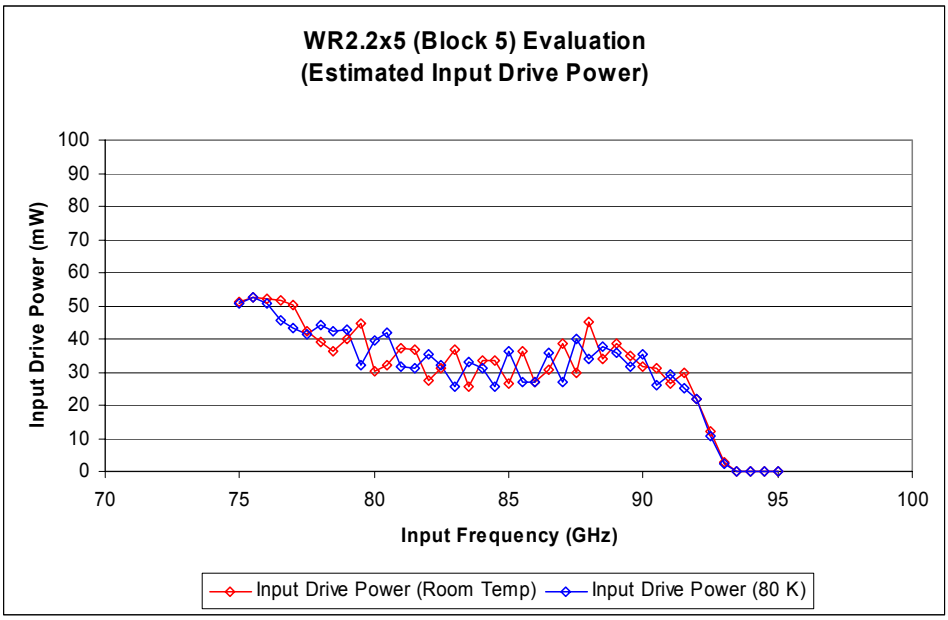

Figure. 3. Estimated input drive power levels at the multiplier input flange.

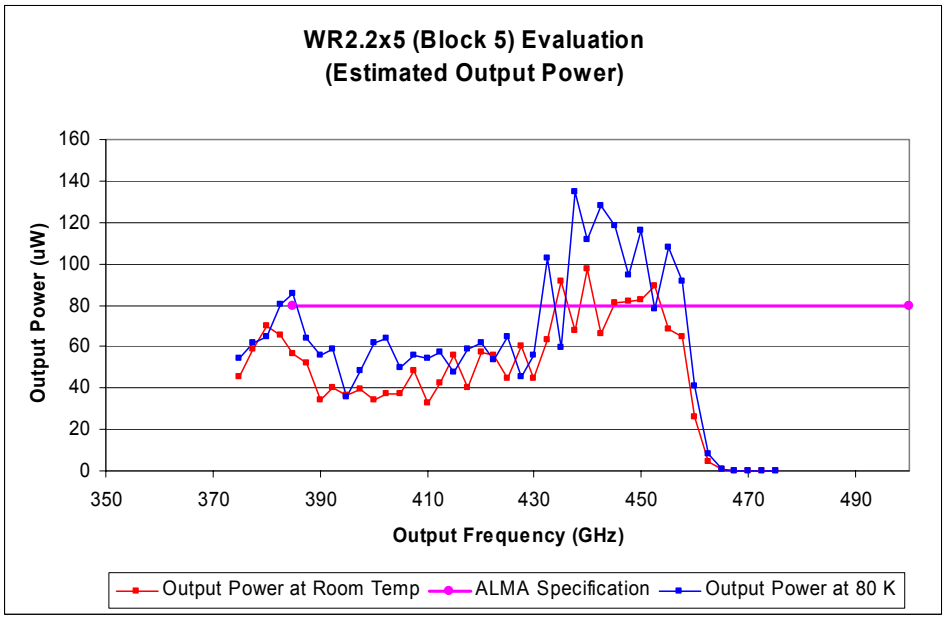

Figure 4. Output power of the frequency quintupler referenced to the multiplier output flange.

Central Development Laboratory

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. These driver components are part of a subassembly called the Warm Cartridge Assembly (WCA) which interfaces to the cartridge on the back of the cryostat.

An overview paper of this work was presented in September at the 2005 IRMMW-THz Symposium. Posters were prepared describing ALMA first LO development and construction for the NRAO Community Open House.

The second pre-production Band 3 WCA was delivered to HIA. This is the first Band 3 WCA to include a dual-channel variable output power amplifier (PA). The first pre-production Band 3 WCA will be retrofitted with this amplifier. Power amplifiers and WCAs are completed and ready to be integrated into pre-production units 3-5.

Based on Accelerated Life Testing (ALT) of the InP power amplifiers and the fact that we are at the high limit of available power at the low end of the Band 6 frequency range, we are investigating the use of a GaAs MMIC power amplifier replacement. A prototype was recently tested with the second Band 6 cold cartridge and showed no measurable difference in terms of sideband noise from the InP power amplifier, but with much more available power than needed by the Band 6 cartridge. Further tests are ongoing to determine the best configuration for a new Band 6 active multiplier chain (AMC)-power amplifier set (the Band 6 AMC may also switch from InP to GaAs).

All four Band 7 laboratory test LOs were delivered to IRAM along with the second pre-production WCA.

For Band 9, drivers using GaAs pHEMT MMIC power amplifiers are being investigated. MMIC power amplifiers were designed and submitted to the foundry. These designs have all passed foundry Design Rule Check (DRC) and will be delivered to NRAO for testing in January 2006. New amplifier designs include a 60-72 GHz, 200 mW design to drive a doubler-quintupler for Band 9, as well as designs for Bands 4 and 8. The Band 9 driver PA layout is shown in Figure 5. Meanwhile, for the second pre-production Band 9 WCA, a power amplifier that combines the output of four MMIC amplifiers was successfully built, tested, and integrated into a WCA currently undergoing final testing before delivery to SRON.

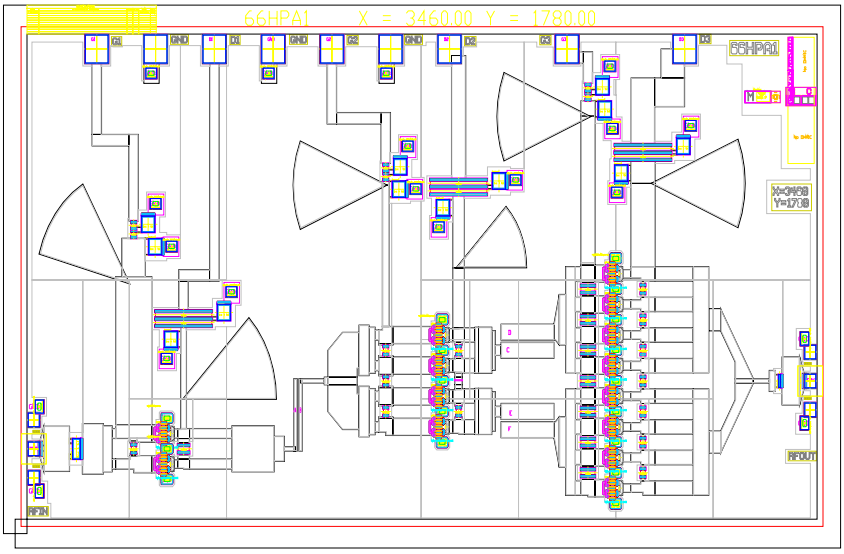

Figure. 5. MMIC layout of GaAs power amplifier to drive cold x10 multiplier cascade for the Band 9 first LO. This MMIC will be fabricated with many other new designs and delivered to NRAO for testing in January.

A pre-prototype WCA to support preliminary cartridge testing of both Bands 4 and 8 has been assembled and is undergoing final qualification before delivery to Japan. Designs for AMC and PA modules for both these bands have begun and will be fabricated before the new MMIC GaAs power amplifiers are delivered in January.

A post-doc from the ASIAA Institute in Taiwan has been here since April investigating the possible use of MMIC HBT VCOs for the ALMA LOs. This work has the potential to eliminate much of the expense, volume, and heat-load burden caused by the use of commercial YIG-tuned oscillators. Currently under test are prototype wideband VCO topologies using packaged HBTs and varactor diodes to investigate design techniques for wideband VCO and to verify the accuracy of phase noise simulations. The design and simulation of a MMIC VCO using the WIN Semiconductor's HBT process has also begun.

Green Bank Solar Radio Burst Spectrometer (GB/SRBS)

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

Central Development Laboratory

Agile Solar Radiotelescope (FASR) project. A significant portion of the development work is being performed at the NRAO Technology Center (NTC) in Charlottesville. Solar activity continues to be monitored over the 20-70 MHz and 250-1000 MHz bands by GB/SRBS Phase II.

The commissioning phase of the 250-1000 MHz upgrade is completed, and we are now observing the sun daily over a seven-hour period. Archived data products are made available to the solar research community via a web link.

The 70-300 MHz, dual-polarization, wide-bandwidth antenna is currently being fabricated in Green Bank. Deployment is scheduled for December 2005.

The data acquisition system and frequency downconverter for the 100-ms sweep option over the 30-300 MHz band are completed (part of GB/SRBS Phase III). The 300-2500 MHz downconverter is under development.

A set of antennas to replace the existing dipole for 10-90 MHz is under development. These antennas will be scaled versions of a sleeved-dipole design which provides a wide field-of-view and good impedance matching over a 40-percent bandwidth. Deployment is scheduled for the second quarter of 2006.

An improved 300-3000 MHz feed/LNA package is being designed for GB/SRBS. This task is being performed by a graduate student as part of the NRAO-UVA Instrumentation Program. The feed will also serve as a prototype for FASR.

Computing and Information Services

Computing and Information Services (CIS) Highlights

Although this has been a tight year, we have managed to make some progress on modernizing our infrastructure. An upgraded email facility to reduce unwanted and unsolicited messages (spam) has been deployed. The installation of the enhanced NRAO intranet backbone at 20 Mbps was delayed last quarter, but it should be finally deployed in the coming quarter. A new Common Computing Environment project to co-ordinate the deployment of Apple Macs was started.

Personnel

We welcome two new colleagues—Josh Malone and Greg Patterson—who will provide much needed assistance in the local and observatory-wide support of Unix and Windows computers operations respectively.

Budget

Although this has been a tight year, we have managed to make some progress on modernizing our infrastructure. With the performance of personal computers largely static for a while, we have placed emphasis on replacing low-end systems. Most user systems at the Observatory with a speed less than 1 GHz have been replaced. In addition, we will have replaced some Linux systems with Mac OS/X systems.

Security

We are pleased to report that, during the past quarter, there were no computer security incidents. This is a direct result of the cumulative effort over the last five years to adhere to the NRAO Computing Security Policy. Brian Glendenning (ALMA) has been appointed to the NRAO Computing Security Council to provide the new function of Software Developer Liaison.

Common Computing Environment (CCE)

Milestone	Original Deadline	Revised Deadline	Date Completed
Improve SPAM mitigation	09/30/05		09/30/05
Start new CCE initiative for Macs	09/30/05		09/30/05

Significant effort was spent evaluating a commercial product to reduce the amount of "spam" (unwanted junk e-mail) being delivered to staff mailboxes. However, after extensive testing we

eventually concluded that that the enhanced version of the system that we were already using provided protection that was at least as good as the commercial product. We have therefore decided to stay with our existing solution of three separate products (MailScanner, Sophos AVI, and SpamAssassin). Of these, only one component (Sophos) is a commercial product.

We are acquiring more MacIntosh computers, especially laptops for the scientific staff. To produce and support a standard environment for users, especially through the upgrade of the OS/X operating system, we have formed an independent CCE effort for this platform to be in parallel with the ones for Windows and Unix. The latter group concentrates more on configurations for Linux and general services.

Web Infrastructure

Milestones	Original Date	Revised Date	Date Completed
Provide electronic payment mechanism	10/31/05		
Upgrade of Web servers	03/31/06		

There has been interest in providing a standard electronic payment mechanism to support registration for conferences. The NRAO has not previously supported this. Since we do not have the appropriate security facilities, we cannot allow credit card information on our networks. We will outsource this function to a commercial provider with a standard procedure for conference organizers to use.

Shortages of disk space on the (now four-year-old) web servers have been temporarily mitigated in several ways. Additional disks were added to the system in Socorro, and old material removed in a disk space cleanup effort in Charlottesville. However, these systems are at the end of their useful life and will be replaced with more modern, capable hardware this fiscal year.

The small web administration group continues to collaborate with, and offer help to the Web-Based Business Services deployment team. This has included the generation of secure sockets layer (SSL) certificates.

The future of web services at the NRAO is being addressed in a wider-ranging proposal led by EPO. This will include improved content management, better navigability, a new structure, and possibly eventually a new look and feel.

Computing and Information Services

Charlottesville Computing

The rewiring of the old part of the Edgemont Road building is now essentially complete, apart from that needed to provide wireless Ethernet support. The second floor rewiring is no longer a high priority since the computer support staff will, for the time being, remain in their first floor accommodations.

A Citrix Metaframe server was deployed during the quarter. While its main purpose was to serve as a way for librarians in Green Bank and Socorro to access the crucial Inmagic catalogue system with reasonable celerity (and in this it has been successful), a very useful side effect is to make available yet another way for those running non-Microsoft operating systems (Linux, OS/X) to access Microsoft applications on their desktops without the need for dual boot or installing virtual machines.

Observatory-wide Communications

Milestones	Original Date	Revised Date	Date Completed
Upgrade network services to VLBA SC antenna	09/30/04	08/31/05	08/17/05
20 Mbps service between the major NRAO sites	08/31/05	10/31/05	
New interconnection of switches in Green Bank	03/31/06		

We have decided to upgrade the intranet backbone between the three major sites from T1 service to T3/DS3 service. This will provide better communication between the sites, including increased support for data and video traffic, and will provide greater access from Green Bank to the Internet and Internet2. At present, the sites have two or three T1 (1.5 Mbps) connections. When the new network is installed, we will have 20 Mbps available at each location. The previous goal was to have this deployed in September. However, the communication providers have been sidetracked by their need to respond to the fallout from Hurricane Katrina, so completion of the installation will probably be delayed about a month.

As a result of lower costs for our intranet contract with AT&T, we decided to upgrade the service to the St. Croix VLBA antenna. This had been in the works for over a year, but was finally completed in August.

It is clear that the Ethernet switches in Green Bank are becoming outdated and have reached their limit for expansion. Furthermore, we no longer have staff members who are conversant with the operating system on those switches. The initial new switch is in operation; a second switch to act as the main local hub was acquired last quarter. The full deployment of the second switch will require new fiber inter-connections between the main communication rooms. Presently, we do not know exactly when this will be done, since the fiber has a several month delivery time.

Education and Public Outreach

Education and Public Outreach (EPO) Highlights

Forty-one images were submitted by 21 individuals to the first annual NRAO / AUI Image Contest. First and second prizes, and seven honorable mentions, were awarded. EPO personnel presented three display papers and one educational workshop at the Astronomical Society of the Pacific's annual conference. A PBS Nova film crew visited the VLA to acquire footage for a program on black holes. Fifty-six students participated in a successful two-week West Virginia Governor's School for Mathematics and Science at Green Bank. The NRAO, White Sands Missile Range, and New Mexico Institute of Mining and Technology collaborated on multiple events to celebrate the 100th anniversary of Einstein's *annus mirabilis*. Three teachers participated in the 2005 NRAO Research Experiences for Teachers (RET) program. Compared to the same months in 2004, visitation at the VLA Visitor Center decreased by 9.0%; visitation at the Green Bank Science Center increased by 13.5% during the same period.

Legacy Imagery Project

The first annual NRAO / AUI Image Contest concluded this quarter. This contest seeks to involve the community in generating high-quality images from observations made with any of the NRAO telescopes. The contest was announced at the Summer 2005 American Astronomical Society (AAS) Meeting in Minneapolis, in the July 2005 NRAO Newsletter, and on the NRAO web site. The contest submission deadline was September 1, 2005 and a total of 41 images and image compositions were received by this deadline from 21 individuals.

In September, the received images were incorporated into the on-line Image Gallery. Hard-copies were made at the standard 300 dpi for consideration by the Image Contest Panel. Panel members were Claire Chandler (NRAO), Kelsey Johnson (UVa), Mark Adams (NRAO), Tim Bastian (NRAO), and Juan Uson (NRAO), chair. The panel voting was double-blind with no identification attached to the images except for the title assigned by the submitters. Details were only known to the panel chair, who abstained from voting.

The Panel adjudicated the prizes below, and the chair has notified the winners. These images are viewable on-line at *http://www.nrao.edu/imagegallery/image_contest/image_contest_prizes.shtml*.

First Prize ($1000): *Virgo, A Laboratory for Studying Galaxy Evolution*
Aeree Chung (Columbia University)

Second Prize ($500): *3C58*
Michael Bietenholz (York University, Canada)

Seven Honorable Mentions ($100 each)

The Radio Sun
Stephen White (University of Maryland)

The HI Disk of NGC2403
Tom Oosterloo (Astron, The Netherlands)

Star Formation in NGC 3596
Aaron Boley (Indiana University)

Star Birth Triggered by a Jet from a Black Hole (Minkowski's Object)
Steve Croft (Lawrence Livermore National Observatory)

Violent Milky Way's Halo HI (image 2)
Yurii Pidopryhora (Ohio University and NRAO)

Fornax A Polarization
Ron Ekers (Australia Telescope National Facility)

The Crab Nebula Rising over the Alps
Michael Bietenholz (York University, Canada)

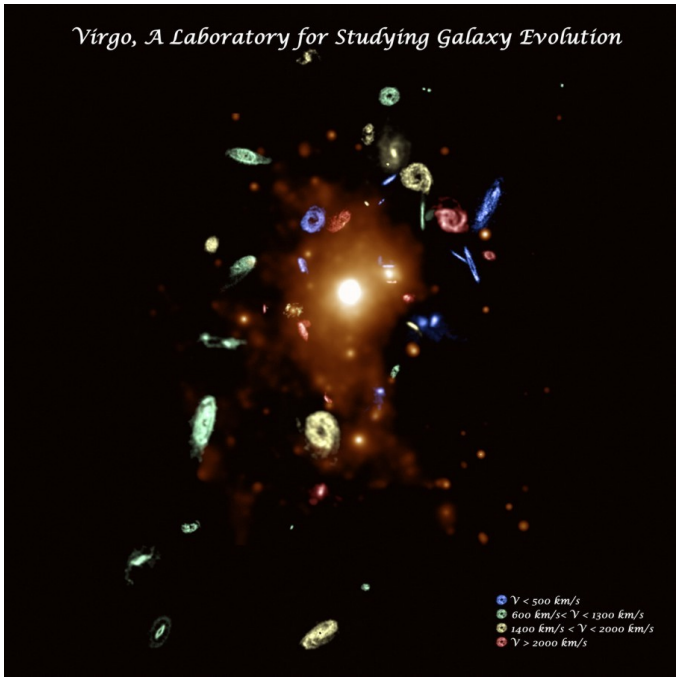

Figure.1. The First Prize image from the NRAO/AUI 2005 Image Contest.

Education and Public Outreach

Astronomical Community

EPO personnel actively participated in the Astronomical Society of the Pacific (ASP) conference held September 14-16, 2005 in Tucson, AZ: "*Building Community: The Emerging EPO Profession*." More than 370 EPO professionals and educators attended this productive meeting. NRAO personnel presented three display papers and one educational workshop that described the Observatory's EPO programs and goals. EPO staff also attended a State of the Art Telescope Education Collaboration (STARTEC) meeting immediately prior to the ASP conference.

The NRAO also hosted the second annual *StarQuest* Star Party for the amateur astronomy community at Green Bank, July 6-9.

News / Media

A Public Broadcasting System (PBS) Nova program film crew visited the Very Large Array this quarter to acquire footage for a program on black holes. The PBS crew, led by producer Tom Lucas, interviewed UC – Berkeley post-doc Geoff Bower while he observed the Galactic Center.

Education

The 2005 summer education program season was a busy one at Green Bank and Socorro.

A successful NRAO Chautauqua program was held with ten participants at the New Mexico Array Operations Center in July. This three-day summer residential education program serves undergraduate science faculty and has been a key element of the NRAO Education program for 18 years.

The 2005 West Virginia Governor's School for Mathematics and Science (GSMS) was held at Green Bank, in collaboration with the National Youth Science Foundation, July 31 – August 13. Funded by the West Virginia Experimental Program to Stimulate Competitive Research (EPSCoR), this program provided unique learning opportunities for the 56 gifted eighth-grade students who attended and had been selected from the more than 300 students who applied. The 2005 GSMS program was a synergistic mix of National Youth Science Camp activities and the research institute program that NRAO has offered teachers since 1987. The GSMS seeks to help promising middle school students understand scientific research. Students were organized into 11 small research teams and given observing projects on the 40 Foot Telescope. Each of the eleven research teams also received one hour of telescope time on the Robert C. Byrd Green Bank Telescope.

The National Radio Astronomy Observatory, White Sands Missile Range (WSMR), and the New Mexico Institute of Mining and Technology collaborated on a series of events celebrating the 100th anniversary of Albert Einstein's *annus mirabilis*. Activities began Friday, July 15, with a special exhibit in the Skeen Library on the New Mexico Tech (NMT) campus entitled "*Warriors: the Navajo Codetalkers*," on

loan from the National Atomic Museum. An evening lecture on the history of the first atomic bomb by Jim Eckles (WSMR) followed. On Saturday, July 16, both the Very Large Array (celebrating its 25th anniversary) and the Trinity Site (celebrating its 60th anniversary) were open for special public tours. An evening lecture in the NMT Skeen Library by NRAO Assistant Director Jim Ulvestad described the history of the Very Large Array. On Friday, September 30 (in preparation for both sites opening for their regular fall tours), NRAO sponsored the performance of the play "Einstein: A Stage Portrait", a collaboration with the New Mexico Tech Performing Arts Series.

Figure 2. The 2005 Governor's School for Mathematics and Science students at Green Bank.

Three teachers participated in the 2005 NRAO Research Experiences for Teachers (RET) program: one in Socorro, and two in Green Bank. Kurt Voss is a chemistry teacher on the Zuni Reservation in New Mexico. Voss collaborated with his RET advisor, Mark Claussen, on a study of low-mass star formation. Mr. Voss is teaching the Zuni's first-ever astronomy course this fall. Vincent Pereira (Englewood, NJ) and Eric Kearsley (Silver Spring, MD) participated in the RET program at Green Bank this summer. Mr. Pereira's research advisor was Brian Mason, and their research project involved developing imaging algorithms for a new high-frequency Green Bank Telescope (GBT) receiver. Karen O'Neil was Mr. Kearsley's research advisor on a research project that measured dust in low surface brightness galaxies.

The NASA / NRAO "*Living with a Star*" Teacher Workshop was held in July, as was the Hands-On Universe Teacher workshop.

Education and Public Outreach

Visitor Centers

Table 1 lists the visitation figures for the Green Bank Science Center and the VLA Visitors Center for July – September 2005. Visitation at the VLA Visitor Center for these three months decreased by 9.0% (654 persons) compared to the same period in 2004; visitation at the Green Bank Science Center, however, increased by 13.5% (2,598 persons).

Table 1. Green Bank Science Center and VLA Visitor Center visitation.

Site	Jul 05	Aug 05	Sep 05	Total
Green Bank	10,470	7,853	3,515	21,820
VLA	3,316	1,953	1,350	6,619

Environment, Safety, and Security

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

This quarter, the ALMA Safety program was initiated and policy development began to ensure safety requirements are followed within ALMA. In New Mexico, ES&S led the efforts to complete the annual National Fire Protection Association inspection and testing of the fire protection system for the VLA site. This quarter provided an opportunity to provide safety training to VLBA station technicians and two safety inspections were completed at VLBA sites. At Green Bank, the system checks for the CO2 fire suppression system at the 43m antenna were completed. The fire hydrants at Green Bank were checked/flow-tested to ensure proper discharge. In Charlottesville, Fire Prevention and Fire Extinguisher training was provided at both the Edgemont Road and NTC facilities. During FY 2006, ES&S will be leading the effort to perform an Observatory-wide environmental audit to focus on compliance with environmental requirements.

ALMA

This quarter, the ALMA Safety Office program structure was drafted and a visitor safety web page developed. The web page is planned for use by institutions using the ALMA site for access to other projects. Several hazard analyses were performed and reviewed to address design and construction safety issues. A Construction safety plan was developed for review with on-site ALMA project construction activities. Safety policy development is in full swing and policies are being prepared to comply with AUI/NRAO requirements as well as European norms and Chilean requirements. We plan to work closely with ESO to ensure all partners are included in this very important effort for safety policy. Consideration is included for Japanese safety requirements as well as our most recent partner.

NRAO-New Mexico

In New Mexico, ES&S led the efforts to complete the annual National Fire Protection Association, NFPA 25, inspection and testing of the fire protection system for the VLA site. Several issues were addressed including the update of the main fire alarm control panel and the repair of the sprinkler system. At the AOC, ES&S led the evacuation warden training session and conducted a fire drill evacuation.

As part of the above AOC review, bloodborne pathogen training and the exposure control program were reviewed and training provided as well. ES&S negotiated with NM Tech for waste disposal and management of blood and body fluid contaminated items. Sharps disposal units were also distributed at the facility.

Environment, Safety, and Security

This quarter provided an opportunity to provide safety training to VLBA station technicians. Over several days, ES&S presented nine safety topics to half of the VLBA technicians. This provided a valuable opportunity for essential safety orientation to this important group of employees. Additionally, we just completed safety inspections at the Kitt Peak, Arizona, and the Pie Town, New Mexico VLBA sites.

At the NM sites, several inspections were conducted including ladders and access control, emergency exit signs, emergency lighting, emergency eye wash and shower units, and personal fall protection (harnesses and lanyards).

Lastly, during this quarter, two ES&S staff members attended the National Safety Congress and Expo to promote the NRAO and to keep current on emerging safety practices.

NRAO-Green Bank

This quarter, ES&S efforts continued on the MIT/LL 43m project, with efforts to address fire suppression and emergency lighting. Also, system checks for the CO2 fire suppression system were completed. The system check included removal from service, hydrostatic testing and recharge of the CO2 fire suppression cylinders, as well as a system-wide inspection of the discharge piping. The system is currently on-line and in compliance with applicable requirements for safe use of a gaseous fire suppression system.

General site fire safety issues addressed this quarter include procurement of flammable storage cabinet for use in the paint shop facility. In August, the annual inspection of the site sprinkler systems was completed. Additionally, the fire hydrants at Green Bank were checked/flow-tested to ensure proper discharge. A hands-on fire extinguisher and fire prevention training was presented to Green Bank staff during September.

Additional inspections and testing were initiated including noise reading sampling to determine levels associated with various pieces of heavy equipment (end loader, riding lawn mowers, cranes, etc.). The annual inspection of site ladders and fall protection equipment including harnesses and lanyards was performed in August. Additionally, the Green Bank rifle club facilities/range was inspected.

NRAO-Charlottesville

In Charlottesville, a minor incident involving a temporary employee occurred. In response to the incident 911 was called. Accordingly, it was discovered dialing 911 did not work properly at the NTC. ES&S investigated and worked with Gene Runion to ensure proper functioning of emergency phone systems at the site. Additionally, Fire Prevention and Fire Extinguisher training were provided at both the Edgemont Road and NTC facilities during August.

Future Efforts

During FY 2006, ES&S will be leading an effort to perform an Observatory-wide environmental audit. The audit will focus on federal compliance with environmental requirements including the Clean Air Act, Clean Water Act, and waste management practices. The audit is planned for all major facilities and a representative VLBA site.

The ES&S Division current staffing level is as follows:

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

Telescope Usage

The NRAO telescopes were scheduled for research and maintenance during the third quarter of 2005 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.

Beginning with 2005 antennas being modified for EVLA are now accounted as downtime for individual projects.

Telescope Usage			
Activity	**VLA** (hrs)	**VLBA** (hrs)	**GBT** (hrs)
Scheduled Observing	1562.50	943.85	1462.00
Scheduled Maintenance and Equipment Changes	195.50	270.20	441.00
Scheduled Tests and Calibration	450.00	440.80	305.00
Time Lost	234.30	43.50	63.00
Actual Observing	1328.20	900.35	1399.00

GBT Observing Programs

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

No.	Observer(s)	Programs
BB191	Barvainis, R. E. (NSF) Ulvestad, J. Birkinshaw, M. (Bristol) Lehar, J. (CombinatoRx)	Are radio-quiet quasars superluminal? 6 cm
BB202	Bower, G. C. (UC, Berkeley) Anderson, J. (Rice)	Trigonometric parallax of a radio star in the Pleiades. 3.5 cm
BB203	Barvainis, R. E. (NSF) Ulvestad, J. Birkinshaw, M. (Bristol) Lehar, J. (CombinatoRx)	Are radio-quiet quasars superluminal? 6 cm
BB208	Barvainis, R. E. (NSF) Antonucci, R. J. (UC, Santa Barbara) Ulvestad, J.	Imaging a water maser at z = 0.66. 2 cm
BB209	Boyce, E. (MIT) Hewitt, J. N. (MIT) Myers, S.	Observations of gravitational lens central images. 3.5 cm, 6 cm
BF084	Forbrich, J. (MPIfR) Massi, M. (MPIfR) Ros, E. (MPIfR) Menten, K. M. (MPIfR)	Selected protostars for the High Sensitivity Array. 3.5 cm
BJ059	Jonker, P.G. (CfA) Chatterjee, S. (CfA) Gaensler, B.M. (CfA) Fender, R.P. (Amsterdam) Maccarone, T. (Amsterdam) Pooley, G. G. (Mullard Radio)	Milliarcsecond scale imaging of the jet in a neutron star. 6 cm

GBT Observing Programs

No.	Observer(s)	Programs
BL132	Lazio, T. J. (NRL) Goss, W. M. Brogan, C.L. (James Clerk Maxwell Telescope) Stanimirovic, S. (UC, Berkeley) Faison, M. (Yale)	Small-scale H I opacity variations toward 3C 147. 21 cm
BM223	Maccarone, T. (Amsterdam) Brisken, W.F. Miller-Jones, J. (Amsterdam) Jonker, P.G. (CfA)	High sensitivity array observations of M 15: searching for emission from intermediate mass black hole candidates. 6 cm
BU027	Ulvestad, J. Neff, S. G. (Goddard) Teng, S. (Maryland)	Monitoring young supernovae in Arp 299. 3.5 cm, 11 cm
GBT01A-078	Stairs, I. (British Columbia) Kaspi, V. (McGill)	A 20 cm search for pulsars in globular clusters. 11 cm
GBT02A-069	Fisher, R.	Galaxy survey of HI emission. 21 cm
GBT02C-025	Greve, T.R. (Caltech) Ivison, R. J. (Royal) Carilli, C. L. Papadopoulos, P. P. (Leiden) Lewis, G.F. (Sydney)	CO(1-0) in the 'big five' high-z sources. 1.3 cm
GBT04A-046	Akos, D. (Stanford) Harrison, N. (Stanford)	Global positioning system satellite anomaly investigation using the Robert C. Byrd Green Bank Telescope. 21 cm
GBT04B-011	Rickett, B. J. (UC, San Diego) McLaughlin, M. (Manchester) Coles, W. A. (UC, San Diego) Lyne, A. G. (Jodrell Bank) Stairs, I. (British Columbia) Camilo, F. (Columbia) Freire, P. (Arecibo)	Scintillation studies of the J0737-3039 binary system. 6 cm, 11 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04B-026	Kramer, M. (Jodrell Bank) Stairs, I. (British Columbia) Camilo, F. (Columbia) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Lyne, A. G. (Jodrell Bank) Manchester, D.R. N. (ATNC) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (Instituto Nationale di Astrofisica) Freire, P. (Arecibo) Joshi, B. (TIFR) Ferdman, R. (British Columbia)	Timing the first double pulsar system. 21 cm, 38 cm
GBT04B-029	Stairs, I. (British Columbia) Camilo, F. (Columbia) Kramer, M. (Jodrell Bank) Faulkner, A. (Jodrell Bank) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Lyne, A. G. (Jodrell Bank) Hobbs, G. (ATNC) Manchester, D.R. N. (ATNC) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (Instituto Nationale di Astrofisica) Ferdman, R. (British Columbia) Ramachandran, R. (UC, Berkeley) Backer, D. C. (UC, Berkeley) Demorest, P. (UC, Berkeley) Nice, D. (Princeton)	Timing new binary and millisecond pulsars from the Parkes Multibeam Survey. 21 cm
GBT04C-008	Pidopryhora, Y. (Ohio) Shields, J. (Ohio) Lockman, F. J.	Mapping the galactic halo HI: evidence of outflow from the galactic plane? 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04C-018	Bolatto, A. (UC, Berkeley) Darling, J. (Carnegie Institute of Washington)	A search for cosmological HI absorption systems toward radio selected flat-spectrum sources. 50 cm
GBT04C-031	Kondratko, P.T. (CfA) Greenhill, L. J. (CfA) Moran, J. M. (CfA) Lovell, J.E.J. (ATNC) Kuiper, T. B. H. (JPL) Jauncey, D. L. (ATNC)	Monitoring of five NGC4258-like water megamasers discovered with the GBT and the DSN. 1.3 cm
GBT04C-043	Ransom, S. Freire, P. (Arecibo) Gupta, Y. (National Centre for Radio Astrophysics)	Timing the eccentric millisecond pulsar binary in globular cluster NGC 1851. 90 cm
GBT04C-050	Lane, W.M. (NRL) Fisher, R. Kanekar, N. Darling, J. (Carnegie Institute of Washington)	Measurement of variable redshifted absorption. 21 cm
GBT05A-003	Campbell, B. (Smithsonian Institution) Carter, L. (Smithsonian Institution) Campbell, D. B. (Cornell)	Radar mapping of the moon at 70-cm wavelength using Arecibo and the GBT. 70 cm
GBT05A-011	Ransom, S. Camilo, F. (Columbia) Stairs, I. (British Columbia) Kaspi, V. (McGill) Hessels, J. W. T. (McGill) Freire, P. (Arecibo)	Timing of the binary and millisecond pulsars in Terzan5. 11 cm, 38 cm
GBT05A-013	Robishaw, T. (UC, Berkeley) Heiles, C. E. (UC, Berkeley)	Threading the magnetic slinky: mapping the Zeeman effect in the Eridanus/Orion region. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05A-014	Bailes, M. (Swiburne) Ord, S. (Sydney) Jacoby, B. (NRL) Kulkarni, S. R. (Caltech) Camilo, F. (Columbia) Hotan, H. (Swiburne) Edwards, (ATNC)	A high sensitivity millisecond pulsar survey. 90 cm
GBT05A-015	Kondratko, P.T. (CfA) Greenhill, L. J. (CfA) Braatz, J. A. Moran, J. M. (CfA)	Search for extragalactic water maser emission with the GBT: independent measurement of the Hubble Constant. 1.3 cm
GBT05A-030	Bania, T. M. (Boston) Rood, R. T. (Virginia) Balser, D.S. Quireza, C. (Universidade de Sao Paulo)	Stalking the cosmic 3-Helium abundance. 3.5 cm
GBT05A-033	Stairs, I. (British Columbia) Camilo, F. (Columbia) Kramer, M. (Jodrell Bank) Faulkner, A. (Jodrell Bank) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Lyne, A. G. (Jodrell Bank) Hobbs, G. (ATNC) Manchester, D.R. N. (ATNC) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (Instituto Nationale di Astrofisica) Ferdman, R. (British Columbia) Ramachandran, R. (UC, Berkeley) Backer, D. C. (UC, Berkeley) Demorest, P. (UC, Berkeley) Nice, D. (Princeton)	Shapiro delay in the PSR J1802-2124 system. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05A-036	Ransom, S. Hessels, J. W. T. (McGill) Kaspi, V. (McGill) Roberts, M. (McGill)	A 350-MHz survey of the northern galactic plane for pulsars. 90 cm
GBT05A-041	Demorest, P. (UC, Berkeley) Backer, D. C. (UC, Berkeley) Ferdman, R. (British Columbia) Stairs, I. (British Columbia) Nice, D. (Princeton) Ramachandran, R. (UC, Berkeley)	Precision timing of binary and millisecond pulsars. 21 cm, 38 cm
GBT05A-048	Camilo, F. (Columbia) Ransom, S. Gaensler, B.M. (CfA) Lorimer, D. (Manchester) Manchester, D.R. N. (ATNC)	Exploratory time request: have we detected the very young pulsar in SNR G21.5-0.9? 38 cm
GBT05A-054	Arzoumanian, Z. (Goddard)	Exploratory time observations of the new relativistic binary pulsar J1906+07. 6 cm, 11 cm, 38 cm
GBT05B-002	Taylor, G.B. (New Mexico) Romani, R. W. (Stanford) Peck, A.B. (CfA) Zavala, R. (United States Naval)	Searching for water masers in the black hole binary system 0402+379. 1.3 cm
GBT05B-003	Lovell, A. (Agnes Scott College) Butler, B. Howell, E. (Arecibo) Schloerb, F. P. (Massachusetts)	OH Observations of 9P/Tempel 1 during Deep Impact. 21 cm
GBT05B-007	Minter, A.	Does pulsar scattering arise in photo-dissociation regions of molecular clouds? 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05B-008	Hollis, J. M. (Goddard) Jewell, P. R. Lovas, F. J. (National Institute of Standards and Technology) Shevlin, P. (NSF) McKee, M. (Auburn) Remijan, A. (Goddard)	Searching for the missing link in sugar polymerization. 1.3 cm, 6 cm
GBT05B-009	Hyman, S. (Sweet Briar College) Lazio, T. J. (NRL) Ray, P.S. (NRL) Kassim, N. E. (NRL)	A coherently-emitting radio transient source toward the Galactic Center? 11 cm, 90 cm
GBT05B-010	Hollis, J. M. (Goddard) Jewell, P. R. Lovas, F. J. (National Institute of Standards and Technology) Remijan, A. (Goddard)	A low frequency search for large-scale glyceraldehyde. 11 cm
GBT05B-011	Minter, A.	Using pulsar HI absorption to determine the distance to the local spiral arm in the second quadrant of the galaxy. 21 cm
GBT05B-013	Araya, E. (New Mexico Tech) Hofner, P. (New Mexico Tech) Goss, W. M. Kurtz, S. (Universidad Nacional Autonoma de Mexico) Olmi, L. (Institute of Radio Astronomy, Bologna) Linz, H. (Thuringer Landessternwarte Tautenburg)	Continuing the GBT search for H_2CO Emission. 6 cm
GBT05B-018	Kanekar, N. Chengalur, J. (National Centre for Radio Astrophysics) Ellison, S.E. (Victoria)	Do the fundamental constants change with time ?

GBT Observing Programs

No.	Observer(s)	Programs
GBT05B-019	Roberts, M. (McGill) Hessels, J. W. T. (McGill) Breton, R. (McGill) Ransom, S. Kaspi, V. (McGill)	Examining the intermittent emission of PSR J1744-3922. 11 cm
GBT05B-020	Morris, M. R. (UC, Los Angeles) Ceccarelli, C. (Observatoire de Grenoble) Wiesenfeld, L. (Universite Joseph Fourier) Valiron, (Universite Joseph Fourier) Faure, A. (Universite Joseph Fourier)	Cyanopolyynes in the Galactic Center. 3.5 cm, 6 cm
GBT05B-021	Lim, J. (Institute of Astronomy and Astrophysics, Academia Sinica) Hsieh, P-Y. (National Taiwan)	The extended HI envelope around the M51 Group. 21 cm
GBT05B-024	Yusef-Zadeh, F. (Northwestern) Hewitt, J. (Allegheny) Roberts, D.A. (Northwestern)	RRL observations of diffuse thermal sources near the Galactic Center nonthermal radio filaments. 3.5 cm
GBT05B-025	Blanton, M. (New York) Geha, M. (Carnegie Institute of Washington) West, A.A. (UC, Berkeley) Pizagno, J. (Ohio) Weinberg, D. H. (Ohio) Dalcanton, J. (Washington) Garcia, D. (Cardiff)	HI content and dynamics of low luminosity galaxies. 21 cm
GBT05B-026	Williams, R. (Ohio) Mathur, S. (Ohio) Nicastro, F. (CfA) Elvis, M. (CfA) Rodriguez, M (CfA)	Searching for 21 cm emission from nearby X-ray Absorbers. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05B-028	Freire, P. (Arecibo) Ransom, S. Hessels, J. W. T. (McGill) Stairs, I. (British Columbia) Begin, S. (British Columbia)	A GBT S-Band globular cluster survey: phase A. 11 cm
GBT05B-029	Bietenholz, M. F. (York) Bartel, N. (York) Ransom, S.	A Search for a 20-year old pulsar in SN 1986J. 11 cm
GBT05B-031	Riechers, D. (MPIfA) Walter, F. (MPIfA) Carilli, C. L. Knudsen, K.K. (MPIfA) Bertoldi, F. (Radioastronomisches Inst.) Beelen, A. (Inst. d'Astrophysique de Paris) Menten, K. M. (MPIfR) Yun, M. (Massachusetts) Scoville, N. Z. (Caltech)	The low-excitation molecular gas content of high-redshift quasars out to z=5.1. 1.3 cm
GBT05B-032	Thorsett, S. (UC, Santa Cruz) Stairs, I. (British Columbia) Arzoumanian, Z. (Goddard)	Timing the millisecond pulsar B1620-26 with the GBT. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05B-034	Stairs, I. (British Columbia) Camilo, F. (Columbia) Kramer, M. (Jodrell Bank) Faulkner, A. (Jodrell Bank) McLaughlin, M. (Manchester) Lyne, A. G. (Jodrell Bank) Hobbs, G. (ATNC) Manchester, D.R. N. (ATNC) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (Instituto Nationale di Astrofisica) Ferdman, R. (British Columbia) Ramachandran, R. (UC, Berkeley) Backer, D. C. (UC, Berkeley) Demorest, P. (UC, Berkeley) Nice, D. (Princeton)	Timing binary and millisecond pulsars from the Parkes Multibeam survey. 21 cm
GBT05B-036	Law, C. (Northwestern) Yusef-Zadeh, F. (Northwestern) Backer, D. C. (UC, Berkeley)	Ionized gas in the Galactic Center lobe. 6 cm
GBT05B-040	Stinebring, D. R. (Oberlin College) Ransom, S. Minter, A.	Scintillation substructure in a sample of pulsars. 90 cm
GBT05B-041	Greve, T.R. (Caltech) Borys, C. (Caltech) Farrah, D. (Cornell) Pihlstroem, Y.(Caltech)	A search for OH gigamasers in two high-z HLIRGs. 38 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05B-042	Kramer, M. (Jodrell Bank) Stairs, I. (British Columbia) Camilo, F. (Columbia) McLaughlin, M. (Manchester) Lyne, A. G. (Jodrell Bank) Manchester, D.R. N. (ATNC) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (Instituto Nationale di Astrofisica) Freire, P. (Arecibo) Joshi, B. (TIFR) Ferdman, R. (British Columbia)	Timing and general relativity in the double pulsar system. 21 cm, 38 cm
GBT05B-044	McLaughlin, M. (Manchester) Possenti, A. (OAC) Stairs, I. (British Columbia) Kramer, M. (Jodrell Bank) Lyne, A. G. (Jodrell Bank) Lyutikov, M. (McGill) Burgay, M. (Instituto Nationale di Astrofisica) Manchester, D.R. N. (ATNC) Freire, P. (Arecibo) Camilo, F. (Columbia)	Studying the interactions in the J0737-3039 system. 90 cm
GBT05B-045	Jacoby, B. (NRL) Cameron, P. (Caltech) Kaplan, D.L. (MIT) Knapp, E.	Searching for pulsars in the newly-discovered globular cluster GLIMPSE-C01. 11 cm
GBT05B-046	Minter, A.	NRAO GB summer student project. 3.5 cm, 6 cm, 21 cm
GBT05B-047	Mangum, J. G.	NRAO CV summer student projects. 3.5 cm, 6 cm, 21 cm
GBT05B-048	O'Neil, K.	NAIC/NRAO workshop projects. 3.5 cm, 6 cm, 21 cm
GBT05B-049	Heatherly, S.	WV Governor's School 3.5 cm, 6 cm, 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05B-052	Kearsly, E. O'Neil, K.	Massive low surface brightness galaxies - RET student project. 21 cm
GBT05B-053	Maddalena, R. Ghigo, F. D. Heatherly, S.	Mapping the Moon and M8 with the GBT - HOU workshop. 3.5 cm
GBT05B-054	Carignan, C. (Montreal) Chemin, L. (Montreal) Lockman, F. J.	HI kinematics in the outer parts of M31. 21 cm
GBT05B-058	Yun, M. (Massachusetts) Langston, G. I. Chen, Y. (CfA)	Completion of the HI survey of 160 micron sources in the Spitzer FLS field. 21 cm
GBT05B-059	Ransom, S. Hessels, J. W. T. (McGill) Freire, P. (Arecibo) Stairs, I. (British Columbia) Camilo, F. (Columbia) Kaspi, V. (McGill)	Confirming the fastest known pulsar. 21 cm
GBT05C-005	Yun, M. (Massachusetts) Borthakur, S. (Massachusetts) Verdes-Montenegro, L. (Insituto de Astrofisica de Andalucia)	What happens to the stripped HI in compact groups? 21 cm
GBT05C-008	Maccarone, T. (Amsterdam) Stappers, B. (Amsterdam) Kundu, A. (Michigan) Zepf, S. (Michigan) Piro, A. (UC, Santa Barbara) Bildsten, L. (UC, Santa Barbara) Kaplan, D.L. (MIT)	Searching for pulsars in dwarf spheroidal galaxies. 90 cm
GBT05C-025	Camilo, F. (Columbia) Gaensler, B.M. (CfA) Lorimer, D. (Manchester) Ransom, S.	Deep searches of six pulsar wind nebulae. 11 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05C-029	Thuan, T. X. (Virginia) Izotov, Y. (Kiev) Hibbard, J. E. Hunt, L. (Instituto Nationale di Astrofisica)	The HI content of extremely metal-deficient blue compact dwarf galaxies. 21 cm
GBT05C-037	Kanekar, N. Carilli, C. L. Langston, G. I. Stocke, J. T. (U. of Colorado, Boulder) Menten, K. M. (MPIfR) Rocha, G. (Cambridge)	Measuring changes in fundamental constants with redshifted OH lines. 38 cm

VLA Observing Programs

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

No.	Observer(s)	Programs
AA298	Araya, E. (NMIMT) Hofner, P. (NMIMT) Goss, W. M. Kurtz, S. (Mexico/UNAM) Olmi, L. (Puerto Rico) Linz, H. (Puerto Rico)	Continuum toward 6cm formahldehyde maser in IRAS 18566+0408. 1.3 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
AB1150	Birzan, L. (Ohio State) McNamara, B. (Ohio State) Carilli, C. Rafferty, D. (Ohio State) Nulsen, P. (CfA) Wise, M. (MIT)	Systems with X-ray cavities. 20 cm
AB1164	Bower, G. (UC, Berkeley) Canizares, C. (MIT) Cheung, C. (Brandeis) Jimenez-Garate, M. (MIT) Markoff, S. (MIT) Falcke, H. (MPIR, Bonn)	Bridging the luminosity gap. 1.3 cm
AB1172	Blomme, R. (Belgium) Prinja, R. (University College) Runacres, M. (Belgium)	New constraints on B-star mass loss rates. 3.5 cm
AB1173	Bash, F. (Texas) Gebhardt, K. (Texas) Goss, W. M. VandenBout, P.	Continuum emission from globular cluster centers. 3.6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AB1178	Bower, G. (UC, Berkeley) Yusef-Zadeh, F. (Northwestern) Roberts, D. (Northwestern) Falcke, H. (MPIR, Bonn) Baganoff, F. (MIT)	Coordinated observations of SgrA*. 0.7, 1.3 cm
AB1179	Bower, G. (UC, Berkeley) Bolatto, A. (UC, Berkeley) Kalas, P. (UC, Berkeley) Matthews, B. (UC, Berkeley) Wright, J. (UC, Berkeley) Graham, J. (UC, Berkeley) Marcy, G. (UC, Berkeley)	Continuum survey of low-mass stars closer than 10 pc. 3.6, 20 cm
AB1180	Bagchi, J. (IUCAA)	Spectral index imaging of the halo in Abell 523. 20, 90 cm
AC730	Clemens, M. (Cambridge) Bressan, A. (Padova) Prouton, O. (Padova) Granato, G. (Padova) Silva, L. (Trieste Obs) Vega, O. (INAOE)	Spectral energy distributions for compact ULIRGs. 3.6 cm
AC750	Clarke, T. (Virginia) Lane, W. (NRL) Sarazin, C. (Virginia) Kassim, N. (NRL)	FRIs in high and low density environments. 90 cm
AC768	Curiel, S. (Mexico/UNAM) Girart, J. (Barcelona) Raga, A. (Mexico/UNAM)	Proper motions of SiO emission in the L1448 outflow. 0.7 cm
AC775	Curiel, S. (Mexico/UNAM) Ho, P. (CfA) Hirano, N. (Hitotsubashi) Zhang, Q. (CfA) Girart, J. (Barcelona)	Structure and kinematics of the SiO outflow in HH211. 0.7 cm

VLA Observing Programs

No.	Observer(s)	Programs
AC776	Clarke, T. (Virginia) Sarazin, C. (Virginia) Markevitch, M. (CfA)	Structure and spectra of the diffuse emission in Abell 520. 20 cm
AC783	Czoske, O. (Bonn) Wucknitz, O. (Hamburg U.) Garrett, M. (NFRA)	Search for halo and relics in merging cluster Cl0024+1654. 20 cm
AC785	Clarke, T. (Virginia) Schmitt, H. (NRL)	Continuum structure of the NGC 507 galaxy group. 20 cm
AC786	Cohen, A. (NRL) Clarke, T. (Virginia) Lane, W. (NRL) Lazio, T. (NRL) Kassim, N. (NRL)	Diffuse emission in Abell 2443. 90 cm
AC787	Chen, Y. (CfA) Zhang, Q. (CfA) Wang, Y. (Texas) Beuther, H. (MPIR, Bonn) Sridharan, T. (CfA) Hunter, T. (CfA)	Survey of NH3(3,3) in massive stellar disk candidates. 1.3 cm
AC801	Chatterjee, S. (Cornell) Lazio, T. (NRL) Cordes, J. (Cornell)	Binary pulsar astrometry. 20 cm
AC802	Claussen, M. Healy, K. (Arizona State) Starrfield, S. (Arizona State) Bond, H. (STScI)	Masers in V838 Mon. 0.7, 1.3 cm
AD508	Duc, P. (CNRS, France) Koribalski, B. (CSIRO) Bournaud, F. (Paris) Brinks, E. (Guanajuato U.) Braine, J. (Bordeaux) Walter, F. (MPIA) Boquien, M. (CEA-Saclay)	Kinematics of the intergalactic HI ring around NGC 5291. 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AD509	Delain, K. ((Minnesota) Rudnick, L. (Minnesota)	Structure and spectra of diffuse sources not in rich clusters. 90 cm
AD511	Domainko, W. (Innsbruck) Feretti, L. (Osservatorio di Bologna) Ferrari, C. (Cote d'Azur) Gitti, M. (Innsbruck) Schindler, S. (Liverpool JMU)	Diffuse emission in galaxy cluster RXJ1347.5-1145. 20 cm
AF422	Furuya, R. (Arcetri) Cesaroni, R. (Arcetri) Shinnaga, H. (CfA)	The cluster of high-mass protostars in G19.61-0.23. 0.7, 6 cm
AF423	Feretti, L. (Osservatorio di Bologna) Orru, E. (Osservatorio di Cagliari) Brunetti, G. (Osservatorio di Bologna) Giovannini, G. (Osservatorio di Bologna) Govoni, F. (Osservatorio di Bologna) Murgia, M. (Osservatorio di Bologna) Setti, G. (Osservatorio di Bologna)	Halo in galaxy cluster A2218. 90 cm
AF424	Fomalont, E. Kelly, J. (U. Virginia) Kellermann, K. Rosati, P. (MPIfEP, Garching) Shaver, P. (ESO)	Spectral indices and variability of sources in UDF and CDFS. 6 cm
AG690	Govoni, F. (Osservatorio di Bologna) Murgia, M. (Osservatorio di Bologna) Feretti, L. (Osservatorio di Bologna) Giovannini, G. (Osservatorio di Bologna) Orru, E. (Osservatorio di Cagliari)	Search for polarized filaments in cluster halos. 20 cm
AG691	Gentile, G. (Bonn) Yegorova, I. (Trieste Obs) Salucci, P. (Trieste Obs) Klein, U. (Bonn) Pizzella, A. (Padova) Jozsa, G. (Bonn)	HI rotation curves of giant spiral galaxies. 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AG694	Gaensler, B. (CfA) Kouvelioutou, C. (NASA) Gelfand, J. (CfA) Taylor, G. Eichler, D. (Ben Gurion) Granot, J. (KIPAC) Wijers, R. (Amsterdam) Ramirez-Ruiz, E. (IAS)	Monitoring the radio afterglow of SGR 1806-20. 3.6, 6, 20 cm
AG695	Garrett, M. (NFRA) Berciano, A. (Kapteyn) Koopmans, L. (Caltech) Wucknitz, O. (Hamburg U.) Muxlow, T. (Manchester) Knudsen, K. (Leiden) vanderWerf, P. (Leiden)	Deep observations of a lensed sub-mm galaxy at z=2.5. 3.6 cm
AG696	Greve, T. (Edinburgh) Knudsen, K. (Leiden) Borys, C. (Caltech) vanderWerf, P. (Leiden) Kneib, J. (Toulouse Obs) Blain, A. (Caltech) Ivison, R. (Royal Obs)	Deep observations of three massive clusters of galaxies. 6 cm
AG697	Gross, C. (NRL) Brogan, C. (Hawaii) Clarke, T. (Virginia) Dickel, J. (Illinois) Kassim, N. (NRL) Weiler, K. (NRL)	Low-frequency imaging of the SNR IC 443. 90 cm
AG699	Giovanelli, R. (Cornell)	Starless ALFALFA source. 20 cm
AH875	Hamidouche, M. (Illinois) Looney, L. (Maryland) Shaw, Y-S. (Illinois)	Circumstellar structures of Herbig Ae/Be stars. 0.7 cm
AH876	Honma, M. (NAO, Japan) Hachisuka, K. (NAO, Japan)	Water masers and UC HII region in G43.8-0.1. 1.3 cm

VLA Observing Programs

No.	Observer(s)	Programs
AH879	Healy, K. (Arizona State) Claussen, M. Hester, J. (Arizona State)	Survey for water masers in nearby molecular clouds. 1.3 cm
AH881	Hibbard, J. Corbin, M. (Arizona State) Vacca, W. (Hawaii)	HI imaging of ultracompact blue dwarf galaxies. 20 cm
AH890	Hyman, S. (Sweet Briar) Lazio, J. (NRL) Ray, P. (NRL) Kassim, N. (NRL)	Bursting GC transient. 20, 90 cm
AJ313	Johnson, K. (Virginia) Plante, S. (Laval)	Structure and spectra of low-metallicity starburst SBS0335-052. 0.7, 1.3, 2, 3.6, 6 cm
AJ320	Jarvis, M. (Leiden) Klockner, H. (Groningen/Kapteyn) Clewley, L. (Oxford) Rawlings, S. (Oxford)	Structures of a complete sample of radio sources. 20 cm
AJ321	Jamrozy, M. (Krakow) Mack, K. (Osservatorio di Bologna) Siemiginowska, A. (CfA) Stawarz, L. (CfA)	Fossil radio lobes. 6 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

VLA Observing Programs

No.	Observer(s)	Programs
AK583	Kulkarni, S. (Caltech) Cameron, B. (Caltech) Soderberg, A. (Caltech) Cenko, S. (Caltech) Frail, D. Harrison, F. (Caltech) Fox, D. (MIT) Gal-Yam, A. (Tel Aviv University) Moon, D-S. (Caltech) Cameron, B. (Caltech)	Gamma-ray bursts, x-ray flashes, and core collapse SNe. 0.7, 1.3, 2, 3.6, 6, 20 cm
AK585	Karovska, M. (CfA) Matthews, L.	Monitoring of maser line and continuum flux densities of Mira. 0.7, 1.3, 3.6, 20 cm
AK604	Kaiser, C. (MPIfEP, Garching) Brocksopp, C. (MSSL) Sokoloski, J. (Southampton) Gunn, K. (Southampton) Fender, R. (Amsterdam)	Imaging a candidate lobe of the microquasar GRS1915+105. 3.6, 6, 20 cm
AK605	Krajnovic, D. (Oxford) Morganti, R. (NFRA) Oosterloo, T. (NFRA) deZeeuw, T. (Leiden) McDermid, R. (Leiden) Cappellari, M. (Leiden) Weijmans, A-M. (Leiden)	The HI disk in the elliptical galaxy NGC 2974. 20 cm
AK606	Kepley, A. (Madison) Wilcots, E. (Wisconsin) Zweibel, E. (Wisconsin)	Polarimetric imaging of the dwarf irregular galaxy NGC 4214. 20 cm
AK622	Kondratko, P. (Harvard) Greenhill, L. (SAO) Moran, J. (SAO)	Discovery of water maser emission in a distant AGN. 1.3 cm
AL637	Laing, R. (Oxford) Hardcastle, M. (Bristol, UK) Bridle, A.	Deep polarimetry of the jets in the FRI radio galaxy 3C 296. 3.6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AL646	Liszt, H. Pety, J. (IRAM) Lucas, R. (IRAM)	HI absorption toward extragalactic continuum sources. 20 cm
AL647	Lang, C. (Iowa) Figer, D. (STScI) Najarro, F. (CSIC)	Structure and spectra of luminous blue variables. 1.3, 3.6 cm
AL652	Landt, H. (STScI) Bignall, H. (JIVE) Padovani, P. (STScI) Perlman, E. (Maryland)	A faint sample of BL Lacertae objects. 20 cm
AL654	Lim, J. (SA/IAA, Taiwan) Hirano, N. (Hitotsubashi) Ohashi, N. (CfA) Takakuwa, S. (CfA)	Imaging binary/multiple protostellar systems. 0.7 cm
AM821	Marecki, A. (Copernicus/Torun) Mack, K. (NFRA)	Structure of potentially restarted sources. 3.6, 6 cm
AM825	Morrison, G. (IPAC) Dickinson, M. (STScI) Owen, F. Bauer, F. (Virginia) Koekemoer, A. (Mt. Stromlo) Mobasher, B. (STScI) Chary, R-R. (Caltech) Frayer, D. (Caltech)	Deep imaging of the GOODS northern field. 20 cm
AM829	Marti, J. (U. Jaen) Benaglia, P. (La Plata) Vink, J. (Imperial College) Maiz-Apellaniz, J. (STScI) Koribalski, B. (CSIRO)	Continuum observations of OB stars. 3.6 cm
AM831	Monnier, J. (CfA) Greenhill, L. (CfA) Tuthill, P. (Sydney) Danchi, W. (NASA/GSFC)	Monitoring the colliding wind binary WR 112. 3.6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AM834	Mundell, C. (Liverpool JMU) Schinnerer, E. (MPIA) Wilcots, E. (Wisconsin) Wilson, A. (Maryland) Dumas, G. (Liverpool)	HI imaging survey of Seyfert galaixes. 20 cm
AM841	Menten, K. (MPIR, Bonn) Schuller, F. (MPIR, Bonn) Schilke, P. (MPIR, Bonn) Alcolea, J. (Yebes Obs)	Masers and continuum toward IRAS 19312+1950. 0.7, 1.3, 3.6, 20 cm
AO196	O'Sullivan, E. (CfA) Harris, D. (CfA) Vrtilek, J. (CfA) Ponman, T. (Birmingham)	NGC 3411 galaxy group. 3.6 cm
AP487	Pandian, J. (Cornell) Momjian, E. (Kentucky) Goldsmith, P. (Cornell)	HI absorption to resolve the distance ambiguity of methanol masers. 20 cm
AP490	Pihlstrom, Y. (UNM) Sjouwerman, L. Fish, V.	Excited OH masers toward supernova remnamts. 1.3, 3.6, 6 cm
AP491	Paladino, R. (Osservatorio di Cagliari) Orru, E. (Osservatorio di Cagliari) Murgia, M. (Osservatorio di Bologna)	Spectral index imaging of spiral galaxies. 90 cm
AP492	Pietu, V. (Grenoble) Testi, L. (Arcetri) Guilloteau, S. (Bordeaux) Natta, A. (Arcetri) Dutrey, A. (Bordeaux)	Imaging the disk of the Herbig Ae star MWC 480. 0.7, 3.6 cm
AP493	Pidopryhora, Y. (Ohio State) Lockman, F.	Structure of cores of galactic halo HI clouds. 20 cm
AR566	Rodriguez, L. (Mexico/UNAM) Anglada, G. (IAA, Andalucia) Torrelles, J. (IAA, Andalucia)	Survey for disks in young binary systems. 0.7 cm

VLA Observing Programs

No.	Observer(s)	Programs
AR568	Reviglio, P. (Columbia) vanGorkom, J. (Columbia)	Imaging galaxies that deviate from the FIR-radio correlation. 20 cm
AR570	Rupen, M. Mioduszewski, A. Dhawan, V.	Monitoring of and triggered response to X-ray transients. 0.7, 1.3, 2, 3.6, 6, 20 cm TRIGGER
AR571	Rodriguez, L. (Mexico/UNAM) Moran, J. (CfA) Franco-Hernandez, R. (CfA) Lizano, S. (Mexico/UNAM)	Hypercompact HII regions in G34.26+0.15. 0.7 cm
AR572	Ribo, M. (Barcelona) Mirabel, I. (CNRS, France) Bel, M. (Barcelona) Goldoni, P. (Barcelona) Chaty, S. (Barcelona)	Triggered observations of a new black hole x-ray nova. 2, 3.6, 6, 20 cm
AR574	Roussel, H. (CNRS, France) Condon, J.J. Helou, G. (IPAC) Beck, R. (MPIR, Bonn)	Galaxies with low synchrotron to dust emission ratios. 3.6, 6, 20 cm
AR575	Ramsay, G. (MSSL/UCL) Wu, K. (Sydney) Slee, O. (CSIRO)	Search for emission from ultra-compact binaries. 6 cm
AS799	Seaquist, E. (Toronto) Muhle, S. (Bonn)	Formaldehyde in starburst galaxy M82. 6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AS801	Schinnerer, E. (MPIA) Carilli, C. Scoville, N. (Caltech) Bertoldi, F. (MPIR, Bonn) Blain, A. (Caltech) Bondi, M. (Osservatorio di Bologna) Ciliegi, P. (Osservatorio di Bologna) Impey, C. (Arizona) Koekemoer, A. (Mt. Stromlo) LeFevre, O. (Marseille Obs) Urry, C. (Yale) Vettolani, P. (Osservatorio di Bologna)	COSMOS deep 1.4 GHz imaging survey. 20 cm
AS805	Shirley, Y. (Arizona) Evans, N. (Texas) Spitzer c2d Legacy Team	Search for ionized gas near the surprising Spitzer-detected source. 3.6, 6 cm
AS831	Shepherd, D. Testi, L. (Arcetri) DePree, C. (Agnes Scott College) Scoles, S. (Agnes Scott College)	Massive outflow sources observed with Spitzer. 3.6 cm
AS832	Skillman, E. (Minnesota)	HI structure and kinematics of ultracompact blue dwarfs. 20 cm
AS838	Stocke, J. (Colorado/JILA) Keeney, B. (Colorado/JILA) Carilli, C.	HI imaging of host galaxies of damped Ly-alpha absorbers. 20 cm
AS839	Siemiginowska, A. (SAO) Cheung, T. (MIT)	Deep VLA imaging of an X-ray cluster associated with a z=1.086 CSS quasar. 20 cm
AS840	Stocke, J. (Colorado/JILA) vanGorkom, J. (Columbia) Zamojski, M. (Columbia) Hibbard, J. Keeney, B. (Colorado/JILA)	A probable HI cloud in a void. 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AS841	Stamatellos, D. (Cardiff) Ward-Thompson, D. (Royal Obs) Whitworth, A. (Cardiff)	Cores with very young protostars. 3.6 cm
AS843	Schillemat, K. (Clarkson) Claussen, M. Shirley, Y. (Arizona) Simpson, C. (Wellesley)	Systematic monitoring campaign for water masers. 1.3 cm
AS845	Shirley, Y. (Arizona) Claussen, M.	Continuum study of two new protostellar candidates. 3.6, 6 cm
AS846	Soderberg, A. (Caltech) Frail, D. Kulkarni, S. (Caltech) Chevalier, R. (Virginia)	Enigmatic type Ibc supernovae and their mysterious engines. 0.7,1.3 cm
AT307	Toribio, M. (Barcelona) Solanes, J. (Barcelona) Uson, J.	Imaging HI deficient spirals on the outskirts of Virgo. 20 cm
AT309	Tsai, C-W. (UCLA) Turner, J. (UCLA) Beck, S. (Tel-Aviv U.)	Imaging candidate supernebulae in starburst galaxies. 1.3 cm
AU104	Umana, G. (Osservatorio di Bologna) Cerrigone, L. (Catania) Trigilio, C. (Osservatorio di Bologna)	Survey of very young PNe candidates. 3.6 cm
AV281	Vollmer, B. (MPIR, Bonn) Beck, R. (MPIR, Bonn) Urbanik, M. (Jagellonian) Otmianowska-Mazur, K. (Krakow) Soida, M. (Jagellonian) Chyzy, K. (Jagellonian) Kenney, J. (Yale) vanGorkom, J. (Columbia)	Polarimetric imaging of Virgo spiral galaxies. 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AV282	Verdes-Montenegro, L. (IAA, Andalucia) Espada, D. (IAA, Andalucia) Bosma, A. (Marseille Obs) Leon, S. (Cologne) Yun, M. (Massachusetts) Athanassoula, E. (Marseille Obs) Sulentic, J. (Alabama)	HI imaging of well-isolated spiral galaxies. 20 cm
AV283	Verheijen, M. (Groningen) Bershady, M. (Wisconsin) Swaters, R. (Maryland) Andersen, D. (MPIA) Westfall, K. (Wisconsin)	HI imaging of spiral galaxies from Disk Mass Project. 20 cm
AW641	Weiler, K. (NRL) Stockdale, C. (NRL) Sramek, R. VanDyk, S. (UCLA) Panagia, N. (STScI) Marcaide, J. (Valencia) Lewin, W. (MIT) Pooley, D. (MIT) Immler, S. (Massachusetts) Ryder, S. (AAO)	Triggered observations of type II SNe. 1.3, 2, 3.6, 6, 20, 90 cm
AW649	Wilcots, E. (Wisconsin) Doane, N. (Wisconsin) Sanders, W. (Wisconsin) Chomiuk, L. (Wisconsin) Zweibel, E. (Wisconsin)	Deep imaging of spiral galaxies with X-ray superbubbles. 6 cm
AW652	Walter, F. (MPIA) Carilli, C. Bertoldi, F. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Cox, P. (IAP, Paris) Weiss, A. (Bonn) Lo, K. (SA/IAA, Taiwan)	Structure of CO in QSO host galaxies beyond redshift four. 0.7 cm

VLA Observing Programs

No.	Observer(s)	Programs
AW657	White, G. (Queen Mary)	Continuum structure of the Beehive proplyd. 3.6 cm
AW659	Wang, Y. (Texas) Zhang, Q. (CfA) Rathborne, J. (Boston) Jackson, J. (Boston) Chambers, E. (Boston)	Survey for water masers and continuum toward MSX dark clouds. 1.3 cm
AW661	Willson, R. (Tufts)	Imaging source regions of coronal mass ejections. 20, 90 cm
AY159	Young, L. (NMIMT) Blitz, L. (UC, Berkeley) Rosolowsky, E. (UC, Berkeley)	HI imaging of early-type galaxies with CO images. 20 cm
AZ161	vanZee, L. (Indiana)	Origin of luminosity-metallicity relation. 20 cm
AZ162	Zapata, L. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Ho, P. (CfA) Garay, G. (Chile)	Methanol masers and continuum towards protostar IRAS 16547-4347. 0.7 cm
BB203	Barvainis, R., (NSF), et al.	Structure of radio-quiet quasars. 6 cm
BB209	Boyce, E. (MIT), et al.	Observations of gravitational lens central images. 3.6, 6 cm Phased array VLBI
BF084	Forbrich, J. (MPIR, Bonn), et al.	Non-thermal Emission from protostars. 3.6 cm
BG156	Giroletti, M. (Osserv di Bologna), et al.	Kinematics in compact symmetric object 4C31.04. 6cm
BJ059	Chatterjee, S. (Cornell) Gaensler, B. (CfA) Fender, R. (Amsterdam) Maccarone, T. (Amsterdam) Pooley, G. (Cambridge)	Imaging jet in neutron star binary Ser X-1. 6 cm

VLA Observing Programs

No.	Observer(s)	Programs
BL132	Lazio, T.J.W. (NRL) Goss, W.M. Brogan, C. (Hawaii) Stanimirovic, S. (Calif., Berkeley) Faison, M. (Yale)	Search for HI opacity variations toward 3C147. 20 cm
BM223	Maccarone, T.J. (Univ. Amsterdam) Brisken, W. Miller-Jones, J. (Oxford) Jonker, P. (CfA)	Imaging faint sources toward the globular cluster M15. 6 cm
BM231	Mioduszewski, A. Hynes, R.I. (Texas-Austin) Rupen, M. Dhawan, V.	Imaging the quiescent black hole candidate V404 Cyg. 3.6 cm
BR102	Ratner, M. (CfA) Bartel, N. (York) Bietenholz, M. (York) Lebach, D. (CfA) Lederman, J. (York) Lestrade, J-F. (Meudon) Ransom, R. (York) Shapiro, I. (CfA)	Astrometric monitoring of HR 8703 in 2005 for GPB mission. 2, 3.6, 6 cm
S60120	Mauche, C. (LLNL) Osborne, J. (Leicester) Abada-Simon, M. (Paris Obs) Cortina, J. (IFAE) Gomer, R. (Rice) Harlaftis, E. (Athens) Horne, K. (St. Andrews) Liedahl, D. (LLNL) Meintjee, P (Univ. Free State) O'Brien, K. (Amsterdam) Pearson, K. (Louisiana State) Robinson, E. (Univ. Texas) Skidmore, W. (Calif., Irvine) Torres, D. (LLNL) Welsh, W. (San Diego State) Wynn, C. (Leicester)	Chandra/VLA observations of binary AE Aqr. 3.6 cm

VLA Observing Programs

No.	Observer(s)	Programs
S60405	Fender, R. (Amsterdam) Gallo, E. (Amsterdam) Jonker, P. (Cambridge) vanderKlis, M. (Amsterdam) Maccarone, T. (Brera Obs) Merloni, A. (MPA) Miller-Jones, J. (Oxford)	Chandra/VLA observations of binary A0620-00. 3.6 cm
S60570	Audard, M. (Columbia) Briggs, K. (PSI) Brown, A. (Colorado/JILA) Gizis, J. (IPAC) Guedel, M. (PSI) Osten, R. Telleschi, A. (PSI)	Chandra/VLA observations of brown dwarfs. 3.6 cm
S60636	Fabbiano, G. (CfA) Siemiginowska, A. (CfA) Elvis, M. (CfA) Baldi, A. (Hawaii) Pellegrini, S. (Osservatorio di Bologna) Greenhill, L. (CfA)	Chandra/VLA observations of nucleus of NGC 821. 3.6, 6 cm

VLBA Observing Programs

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

No.	Observer(s)	Programs
BB191	Barvainis, R. (NSF) Ulvestad, J. Birkinshaw, M. (Bristol, UK) Lehar, J. (CfA)	Radio-quiet quasars. 6 cm
BB202	Bower, G. (UC, Berkeley) Anderson, J.	Trigonometric parallax of a star in the Pleiades cluster. 3.6 cm
BB203	Barvainis, R. (NSF) Ulvestad, J. Birkinshaw, M. (Bristol, UK) Lehar, J. (CfA)	Structure of radio-quiet quasars. 6 cm
BB208	Barvainis, R. (NSF) Antonucci, R. (UC, Santa Barbara) Ulvestad, J.S.	Imaging a water maser at z=0.66. 2 cm
BB209	Boyce, E. Hewitt, J. (MIT) Myers, S.	Observations of gravitational lens central images. 3.6, 6 cm
BB210	Boboltz, D. (USNO) Driebe, T. (MPIR, Bonn) Ohnaka, K. (MPIR, Bonn) Wittkowski, M. (ESO)	Coordinated VLBA/VLTI Obs. of AH Sco and RR Aql. 0.7 cm
BB211	Bower, G. (UC, Berkeley) Falcke, H. (MPIR, Bonn) Markoff, S. (MIT) Canizares, C. (MIT) Jimenez-Garate, M. (MIT)	Coordinated observations of the LLAGN M81*. 1.3, 3.6 cm
BB213	Brisken, W. Romani, R. (Stanford)	Pulsar J0538+2817: Four more epochs. 20 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BC151	Cotter, G. (Oxford) Bolton, R. (Cambridge) Chandler, C. Lee, D. (Oxford) Pearson, T. (Caltech) Pooley, G. (Cambridge) Readhead, T. (Caltech) Riley, J. (Cambridge) Waldram, E. (Cambridge)	Compact radio sources selected at 15 GHz. 6 cm
BC152	Claussen, M. Marvel, K. (AAS) Simpson, C. (Wellesley) Wilking, B. (UMSL) Wootten, H.	Parallax and proper motions of water masers in Ophiuchi molecular cloud complex. 1 cm
BC155	Claussen, M. Summer Students	Summer Student Observatioans. 6 cm
BE041	Edwards, P. (ISAS) Tingay, S. (Swinburne)	Motions in the two-sided jets of the low z radio galaxy. 2, 4 cm
BE042	Edwards, P. (ISAS) Falcone, A. (Whipple Obs.) Piner, B. (Whittier College)	Structure and evolution of high-peaked FSRQs. 4, 13 cm
BF084	Forbrich, J. (MPIR, Bonn) Massi, M. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Menten, K. (MPIR, Bonn)	Non-thermal emission from protostars. 3.6 cm
BF086	Fish, V.	Resolving Zeeman splitting question for 1720 and 1612 MHz. 20 cm
BG152	Gabuzda, D. (Copernicus/Torun) Rastorgueva, E. (Moscow/SSAI) Smith, P. (Arizona)	Simultaneous radio and optical polarimetry of AGN jets. 0.7, 1.3, 2 cm
BG156	Giroletti, M. (Bologna) Giovannini, G. (Bologna) Taylor, G. (UNM)	Kinematics in the compact symmetric object 4C31.04. 6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BG158	Giovannini, G. (Osservatorio di Bologna) Cotton, W. D. Feretti, L. (Osservatorio di Bologna) Giroletti, M. (Osservatorio di Bologna) Taylor, G.	Unbiases sample radio galaxies. 6 cm
BG160	Giovannini, G. (Osservatorio di Bologna) Feretti, L (Osservatorio di Bologna) Giroletti, M. (Osservatorio di Bologna) Taylor, G. (UNM)	VLBA obs. of giant superluminal source 1144+35. 20, 6, 4 cm
BH126	Harris, D. (SAO) Cheung, C. (Brandeis) Junor, B. (LANL)	Ongoing outburst of Knot 'HST-1" in the M87 jet. 90 cm
BH127	Hough, D. (Trinity)	Innermost jet structure in nuclei of lobe-dominated quasars 3C207 and 3C345. 1, 2, 4 cm
BJ059	Jonker, P. (Cambridge) Chatterjee, S. (Cornell) Gaensler, B. (CfA) Fender, R. (Amsterdam) Maccarone, T. (Brera Obs) Pooley, G. (Cambridge)	Imaging the jet in the neutron star binary Ser X-1. 6 cm
BK124	Kovalev, Y. Fomalont, E. Gordon, D. (NASA) Petrov, L. (NVI)	Completing the 200 mJy large VLBA sample of extragalactic sources. 4, 13 cm
BK125	Kharb, P. (IIA, Bangalore) Gabuzda, D. (Copernicus/Torun) Shastri, P. (IIA, Bangalore) O'Dea, C. (STScI) Baum, S. (STScI)	Polarimetric imaging of jets in FR I radio galaxies. 2, 3.6, 6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BL122	Lanyi, G. (JPL) Boboltz, D. (USNO) Charlot, P. (Bordeaux) Fey, A. (USNO) Fomalont, E. Gordon, D. (NASA) Ma, C. (NASA) Romney, J. Sovers, O. (Remote Sensing) Taylor, G. (UNM) Ulvestad, J. S.	High precision K/Q Band astrometry. 1, 4, 13 cm
BL123	Lister, M. (Purdue) Aller, H. (Michigan) Aller, M. (Michigan) Arshakian, T. (MPIR, Bonn) Homan, D. (Denison) Kadler, M. (MPIR, Bonn) Kellermann, K. Kovalev, Y. Lovanov, A (MPIR, Bonn). Ros, E. (MPIR, Bonn) Vermeulen, R. (ASTRON) Zensus, J. (MPIR, Bonn)	MOJAVE Program. 2 cm
BL124	Loinard, L. (UNAM/Mexico)) Mioduszewski, A. Rodriguez, L. (UNAM/Mexico) Rodriguez, M. UNAM/Mexico) Torres, R. (UNAM/Mexico)	Parallax and proper motions of young stellar sources in Taurus. 4 cm
BL127	Ly, C. (UCLA) DeYoung, D. (NOAO)	Multi-frequency obs. of SDSS J1048+0055. 2, 4 cm
BL128	Loinard, L. (UNAM/Mexico) Mioduszewski, A. Rodriguez, L. (UNAM/Mexico) Torres, R. (UNAM/Mexico)	Distance to Taurus and Ophiuchus. 4 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BL132	Lazio, T. (NRL) Goss, W.M. Brogan, C. (Hawaii-IFA) Stanimirovic, S. (NAIC) Faison, M. (Northwestern)	Search for HI opacity variations toward 3C 147. 18 cm
BL136	Loinard, L. (UNAM/Mexico) Mioduszewski, A. Rodriguez, L. (UNAM/Mexico) Torres, R. (UNAM/Mexico)	Precise distance to Taurus star-forming region. 4 cm
BM208	Krichbaum, T. (MPIR, Bonn) Middelberg, E. (MPIR, Bonn) Roy, A. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Proper motions in NGC 3079. 1, 6 cm
BM223	Maccarone, T. (Brera Obs) Brisken, W. Miller-Jones, J. (Oxford) Jonker, P. (Cambridge)	Imaging faint sources toward the globular cluster M15. 6 cm
BM224	Ma, C-J. (NASA/GSFC) Gordon, D. (NASA/GSFC) Johnston, K. (USNO) Fey, A. (USNO) Vandenberg, N. (Interferometrics) Gipson, J. (Interferometrics) Boboltz, D. (USNO) Kingham, K. (USNO) MacMillan, D. (Interferometrics) Petrov, L. (NASA/GSFC) Fomalont, E. Walker, R.C.	Geodesy/astrometry observations for 2005. 3.6 cm
BM225	McClintock, J. (CfA) Dhawan, V. Remillard, R. (MIT) Rupen, M.	Multi-wavelength study of a black hole X-ray Nova outburst. 4, 13 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BM227	Moscadelli, L. (Cagliari) Cesaroni, R. (Arcetri) Rioja, M. (OAN, Spain)	Ejection and deceleration of H20 masers. 1 cm
BM229	Marscher, A. (Boston) Aller, M. (Michigan) D'Arcangelo, F. (Boston) Jorstad, S. (Boston) McHardy, I. (Southampton)	Probing compact jets through multi-waveband variability and polarization. 4 cm
BM230	Marscher, A. (Boston) Aller, M. (Michigan) Jorstad, S. (Boston) McHardy, I. (Southampton) Wannawichian, S. (Boston)	Relation between the X-ray state and energy flow into jets of radio galaxies. 0.7 cm
BM231	Mioduszewski, A. Hynes, R. (Texas) Rupen, M. Dhawan, V.	Imaging the quiescent black hole candidate V404 Cyg. 3.6 cm
BM232	Marvel, K. (AAS) Boboltz, D. (USNO)	Measuring the proper motions of the H20 masers toward OH 12.8-0.9. 1 cm
BM233	Mioduszewski, A. Hillwig, T. (Valparaiso U.) Marshall, H. (MIT) Rupen, M.	Coordinated kinematic monitoring of SS 433. 2, 3.6 cm
BM234	Menten, K. (MPIR, Bonn) Reid, M. (CfA)	Parallax and proper motion of Orion X-ray stars. 4 cm
BN027	Nagar, N. (Kapteyn)	Multiple supermassive black holes in merger systems. 6 cm
BP112	Piner, B. (Whittier) Edwards, P. (ISAS) Wiik, K. (ISAS)	Decelerating jets of Mkn 421. 0.3, 0.7 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BP118	Petrov, L. (NASA) Fomalont, E. Gordon, D. (NASA) Kovalev, Y.	VCS4: Filling last remaining holes in calibrator coverage. 4, 13 cm
BP120	Piner, B. (Whittier) Edwards, P. (ISAS) Jones, D. (JPL)	Kinematics of 26 component in the blazar 0827+243. 2 cm
BR099	Ros, E. (MPIR, Bonn) Aller, M. (Michigan) Aller, H. (Michigan) Kadler, M. (MPIR, Bonn) Kerp, J. (Astron. Inst.) Kovalev, Y. Marscher, A. (Boston) Weaver, K. (NASA)	NGC 1052, the key to explore the disk jet connection in AGN. 0.7, 1 cm
BR100	Reid, M. (CfA) Greenhill, L. (CfA) Menten, K. (MPIR, Bonn) Moscadelli, L. (Osservatorio di Cagliari) Xu, Y. (Nanjing) Zheng, X-W. (Nanjing)	Spiral structure and kinematics of the Milky Way. 2 cm
BR102	Ratner, M. (CfA) Bartel, N. (York U.) Bietenholz, M. (York U.) Lebach, D. (CfA) Lederman, J. (York U.) Lestrade, J. (Paris Obs) Ransom, R. (York U.) Shapiro, I. (CfA)	Astrometric monitoring of HR 8703 in 2005 for GPB mission. 2, 3.6, 6 cm
BR107	Ramachandran, R. (UC, Berkeley) Deshpande, A. (Arecibo) Goss, W.M.	Short time scale fluctuations in OH masers. 20 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BS144	Sudou, H. (Gifu) Iguchi, S. (NAOJ) Takaba, H. (Gifu) Taniguchi, Y. (Tohoku) Wakamatsu, K. (Gifu) Murata, Y. (ISAS)	Astrometric monitoring of the radio galaxy 3C 66B. 1, 4, 13 cm
BS157	Savolainen, T. (Tuorla Obs) Pian, E. (INAF) Rastorgueva, E (Tuorla Obs) Valtaoja, E. (Tuorla Obs) Wiik, K. (Tuorla Obs)	Triggered polarimetric monitoring of a blazar in outburst. 0.3, 0.7, 1, 2, 4, 6 cm
BT079	vanderTak, F. (MPIR, Bonn) Hachisuka, K. (MPIR, Bonn) Menten, K. (MPIR, Bonn)	Proper motions of H20 masers in AFGL 2136. 1 cm
BU027	Ulvestad, J. S. Neff, S. (NASA/GSFC) Teng, S. (Maryland)	Monitoring young supernovae in Arp 299. 3.6 cm
BV055	Diamond, P. (Manchester) van Langevelde, H. (JIVE)	Monitoring the magnetic field on water masers of U Ori. 1 cm
RDV053	Gordon, D. (GSFC)	Geodesy/astrometry observation. 4, 13 cm

Personnel

NEW HIRES

Aguirre, James	Research Associate	01-Sep-05
Dressel, Justin	Software Engineer III	15-Aug-05
Kutz, Charles	Electronics Engineer I	11-Jul-05
Malone, Joshua	Systems Administrator II	01-Sep-05
McCarty, Michael	Software Engineer III	06-Sep-05
Meier, David	Research Associate	06-Sep-05

REHIRE

Achermann, Cristobal	Research Assistant	25-Jul-05
Devine, Kathryn	Research Associate, Junior	06-Sep-05
Dunlap, Colton	Engineering Associate, Junior	01-Jul-05
Kelly, Johnk	Research Associate, Junior	01-Sep-05
Palmer, Patrick	Visiting Scientist	01-Jul-05

TERMINATIONS

Palmer, Patrick	Visiting Scientist	31-Jul-05
Achermann, Cristobal	Research Assistant	30-Sep-05
Boyce, Edward	Research Associate, Junior	31-Aug-05
Duplain, Ronald	Engineering Associate, Junior	16-Sep-05
Fleyshman, Grigoriy	Scientist, Visiting	15-Aug-05
Mastrantonio, Erin	Research Assistant	31-Aug-05
McCarney, Benjamin	Research Associate, Junior	05-Aug-05
Morgan, Thomas	Software Engineer I	05-Aug-05
Osten, Rachel	Jansky Fellow	14-Sep-05
Shirley, Yancy	Jansky Fellow	31-Aug-05
Simon, Jared	Engineering Associate, Junior	31-Aug-05
Taylor, Gregory	Associate Scientist/A	12-Aug-05
Winer, Morgan	Engineering Associate, Junior	29-Jul-05
Wurnig, Jason	Scientific Associate III	19-Sep-05

PROMOTIONS

Zivick, Jeffrey	Division Head	11-Jul-05

TRANSFERS

Bolyard, Jody	Safety & Environmental Protection Manager	01-Jul-05
Guo, Dongshan	Software Engineer II	01-Sep-05
Jacques, Christophe	Electronics Engineer II	01-Jul-05
Patterson, James	Systems Administrator II	01-Sep-05
Ye, Honglin	Software Engineer I	01-Jul-05

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BRANCHESI, M.; GIOIA, I.M.; FANTI, C.; FANTI, R.; PERLEY, R. "The Radio Luminosity Function of the NEP Distant Cluster Radio Galaxies."

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CARILLI, C.L. "HI 21cm Probes of Reionization, and Beyond."

CHATTERJEE, S.; VLEMMINGS, W.H.T.; BRISKEN, W.F.; LAZIO, T.J.W.; CORDES, J.M.; GOSS, W.M.; THORSETT, S.E.; FOMALONT, E.B.; LYNE, A.G.; KRAMER, M. "Getting Its Kicks: A VLBA Parallax for the Hyperfast Pulsar B1508+55."

EIROA, C.; TORRELLES, J.M.; CURIEL, S.; DJUPVIK, A.A. "VLA 3.5 cm Continuum Sources In the Serpens Cloud Core."

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Galaxy NGC 864 (CIG 96)."

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FOMALONT, E.B. "Radio Astrometry: Present Status and Future."

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GIOVANELLI, R.; HAYNES, M.P.; KENT, B.R.; PERILLAT, P.; SAINTONGE, A.; BROSCH, N.; CATINELLA, B.; HOFFMAN, G.L.; STIERWALT, S.; SPEKKENS, K.; LERNER, M.S.; MASTERS, K.L.; MOMJIAN, E.; ROSENBERG, J.L.; SPRINGOB, C.M.; BOSELLI, A.; CHARMANDARIS, V.; DARLING, J.K.; DAVIES, J.; LAMBAS, D.G.; GAVAZZI, G.; GIOVANARDI, C.; HARDY, E.; HUNT, L.K.; IOVINO, A.; KARACHENTSEV, I.D.; KARACHENTSEVA, V.E.; KOOPMANN, R.A.; MARINONI, C.; MINCHIN, R.; MULLER, E.; PUTMAN, M.; PANTOJA, C.; SALZER, J.J.;SCODEGGIO, M.; SKILLMAN, E.; SOLANES, J.M.; VALOTTO, C.; VAN DRIEL, W.; VAN ZEE, L. "The Arecibo Legacy Fast ALFA Survey: I. Science Goals, Survey Design and Strategy."

GOMEZ, L.; RODRIGUEZ, L.F.; LOINARD, L.; LIZANO, S.; POVEDA, A.; ALLEN, C. "Dynamical Decay of a Massive Multiple System in Orion KL?"

GREENE, J.E.; HO, L.C.; ULVESTAD, J.S. "The Radio Quiescence of Active Galaxies with High Accretion Rates."

GREISEN, E.W.; CALABRETTA, M.R.; VALDES, F.G.; ALLEN, S.L. "Representations of Spectral Coordinates in FITS."

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JORSTAD, S.G.; MARSCHER, A.P.; LISTER, M.L.; STIRLING, A.M.; CAWTHORNE, T.V.; GEAR, W.K.; GOMEZ, J.L.; STEVENS, J.A.; SMITH, P.S.; FORSTER, J.R.; ROBSON, E.I. "Polarimetric Observations of 15 Active Galactic Nuclei at High Frequencies: Jet Kinematics from Bimonthly Monitoring with the Very Long Baseline Array."

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KOVALEV, Y.Y.; KELLERMANN, K.I.; LISTER, M.L.; HOMAN, D.C.; VERMEULEN, R.C.; COHEN, M.H.; ROS, E.; KADLER, M.; LOBANOV, A.P.; ZENSUS, J.A.; KARDASHEV, N.S.; GURVITS , L.I.; ALLER, M.F.; ALLER, H.D. "Sub-milliarcsecond Imaging of Quasars and Active Galactic Nuclei. IV. Fine Scale Structure."

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LANG, C.C.; JOHNSON, K.E.; GOSS, W.M.; RODRIGUEZ, L.F. "Stellar Winds and Embedded Star Formation in the Galactic Center Quintuplet and Arches Clusters: Multifrequency Radio Observations."

LISZT, H.S.; LUCAS, R.; PETY, J. "Comparative Chemistry of Diffuse Clouds V: Ammonia and Formaldehyde."

LOBANOV, A.; KRICHBAUM, T.; WITZEL, A.; ZENSUS, J.A. "Dual Frequency VSOP Imaging of the Jet in S5 0836+710."

LUTZ, D.; YAN, L.; ARMUS, L.; HELOU, G.; TACCONI, L.J.; GENZEL, R.; BAKER, A.J. "Millimeter Observations of Obscured Spitzer 24 μm Sources."

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MAO, T.F.; BUTLER, B.J.; SLADE, M.A.; HALDEMANN, A.F.C.; MUHLEMAN, D.O. "Goldstone/VLA 3.5 cm Mars Radar Observations in 2003."

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MILLER, N.A. "Star Formation and AGN in the Core of the Shapley Supercluster: A VLA Survey of A3556, A3558, SC1327-312, SC1329-313, and A3562."

MITTAL, R.; PORCAS, R.; WUCKNITZ, O.; BIGGS, A. BROWNE, I. "VLBI phase–reference observations of the gravitational lens JVAS B0218+357."

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NITA, G.M.; GARY, D.E.; FLEISHMAN, G.D. "Spatial Evidence for Transition Radiation in a Solar Radio Burst."

PAPADOPOULOS, P.P.; GREVE, T.R.; IVISON, R.J.; DE BREUCK, C. "A Sensitive Search for CO J=1–0 Emission in 4C 41.17: High-Excitation Molecular Gas at z=3.8."

PÉREZ-TORRES, M.-A.; DE BREUCK, C. "The Extremely Asymmetric Radio Structure of the z=3.1 Radio Galaxy B3 J2330+3927."

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PÉREZ -TORRES, M.A.; DE BREUCK, C.; VAN BREUGEL, W.; MILEY, G. "Very High-Resolution Radio Observations of HzRGs."

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RICKETT, B.J.; LAZIO, T.J.W.; GHIGO, F.D. "Interstellar Scintillation Observations of 146 Extragalactic Radio Sources."

RODMANN, J.; HENNING, T.; CHANDLER, C.J.; MUNDY, L.G.; WILNER, D.J. "Large Dust Particles in Disks Around T Tauri Stars."

RODRIGUEZ-RICO, C.A.; GOSS, W.M.; VIALLEFOND, F.; ZHAO, J.-H.; GOMEZ, Y.; ANANTHARAMAIAH, K.R. "VLA H53α Radio Recombination Line Observations of the Ultraluminous Infrared Galaxy Arp~220."

SAVOLAINEN, T.; WIIK, K.; VALTAOJA, E.; TORNIKOSKI, M. "Multifrequency VLBA Monitoring of 3C 273 during the INTEGRAL Campaign in 2003 - I. Kinematics of the Parsec Scale Jet from 43 GHz Data."

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Budget

The table below represents NRAO Operations (without EVLA) expenses and commitments for Fiscal Year 2005 through the end of the fiscal year as reported at Work Breakdown Structure (WBS) Level 1.

Available funds for NRAO Operations (without EVLA) total $45,225,933. This amount includes $47,033,030 in new NSF Funds (less $5,340k for EVLA Phase 1 construction), $1,726,156 in prior year commitments and $1,806,747 in prior year carryover.

NRAO Operations Expenses and Commitments FY 2005 Year to Date (October 1, 2004 to September 30, 2005)

Work Breakdown Structure Element Level 1	Salaries & Benefits	Materials & Services	Travel	Revenue or Cost Recovery	Total
Observatory Management	$2,620,085	$6,156,550	$407,739	($187,393)	$8,996,981
Education and Public Outreach	$357,052	$184,938	$32,923	($137,267)	$437,646
Central Development Lab	$1,249,058	$281,661	$12,747	$0	$1,543,467
Green Bank Operations	$7,896,120	$2,706,788	$126,929	($632,043)	$10,097,794
New Mexico Operations	$11,858,502	$4,066,203	$200,612	($83,410)	$16,041,907
ALMA Operations	$356,425	$75,792	$17,623	$0	$449,841
Computer and Information Services	$881,140	$585,968	$15,319	$0	$1,482,427
Division of Science and Academic Affairs	$3,764,834	$725,630	$216,514	$0	$4,706,978
	$28,983,216	$14,783,530	$1,030,406	($1,040,112)	$43,757,039