NATIONAL RADIO ASTRONOMY OBSERVATORY

Quarterly Report

January – March 2003

Cover Image: First Jet-Producing Spiral Galaxy 0313-192. Investigators: W. Keel (Alabama), M. Ledlow (Gemini) and F. Owen (NRAO).

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Quarterly Report January - March 2003

Executive Summary

ALMA

The Bilateral ALMA Agreement between the National Science Foundation and the European Southern Observatory was signed on February 25, 2003. This agreement formally establishes the ALMA project, defines the obligations of, and benefits to the parties and forms the management and governance structures of the project. Massimo Tarenghi was appointed as the ALMA Director effective April 1, 2003. The ALMA Board approved the Project Plan submitted by the Joint ALMA Office. Delivery of the VertexRSI prototype antenna was completed in March, and a trial "first light" observation at 3 mm and 1 mm was achieved using the Evaluation Receiver.

EVLA

Installation of the fiber optic cable on the west arm is near completion. Fiber optic connections between the Control Building and maintenance and array test station (W10) were finished, and preparation for the acceptance tests of the connections began. A number of electronic prototype modules were assembled, and the system bench testing was started. Initial tests of the first Module Interface Boards (MIB) were completed.

A major milestone was achieved for the Canadian EVLA correlator project with the announcement on February 17 that the first increment of construction funding is provided in the Canadian 2003 budget.

Green Bank Telescope

In March, first engineering checkouts of the 40-50 GHz (Q-Band) receiver were performed, and the initial results were very promising. The active surface was utilized, and yielded an aperture efficiency at 43 GHz of about 35%, consistent with an RMS surface of 450 micrometers. The beam shapes were also good, with diffraction sidelobes below 20 dB.

Basic commissioning of the GBT is nearly complete, and commissioning time is being reduced in favor of scheduled astronomical observations. The K-Band (18-26.5 GHz) system has been used in both its upper (22-26.5 GHz) and lower (18-22GHz) bands and works well, although the amplifiers in the upper band will be replaced with a new generation of devices this summer. More than 20 auto-correlation modes of the GBT Spectrometer are now available, including bandwidth modes at 12.5,50,200, and 800 MHz.

Progress is being made in eliminating the instrumentally-induced baseline features. By far the largest distortion of (on-off)/off spectra is due to reflections and resonances in the feeds and waveguide structures of the receivers, and design modifications are being developed. Other issues include weak, multi-path reflections from the subreflector edge and the circumferential panel gaps, from reflections in certain IF cables, and in a gain ripple in the modulators for the optical fiber IF links.

Cracks in the surface of a number of wear plates of the GBT track were found, and limitations were placed on the use of the antenna as a result. By the end of the quarter the most seriously cracked wear strip had been replaced, and the others were scheduled to be replaced early in April. The measurement of the wheel load is essentially complete, and a work scope has been established for the analysis of the existing track. A contract has been awarded for a proof-of-concept trial weld, and pending a successful demonstration by early May, a trial section of a modified wear strip design will be installed early in the summer.

The Software Development Division focused on supporting the commissioning of the Q-Band system, active surface improvements, development of the engineering measurement system's first phase, and the overhaul of spectrometer software to address reliability issues. The Project Office was opened late in the quarter. The regular monthly releases of the updated version of the monitor & control software continued.

Very Large Array & Very Long Baseline Array

In March 2003, the New Mexico Senate voted to pass a resolution which returns ownership of the VLA Visitor Center to the National Science Foundation (NSF). The center was built in 1983 using state funds and land donated by the state to the NSF. The state has been responsible for major repairs to the center while NRAO has taken care of its day-to-day maintenance. Under the new arrangement, NRAO will be able to make significant modifications to the building for its education and public outreach programs, and the construction of an addition to the center has already begun.

The high frequency performance of the VLBA antenna is limited by surface imperfections in the subreflector of the antenna. A program to measure and resurface the subreflectors was initiated in late 2002. In February 2003, a spare subreflector that had been re-figured to achieve a surface accuracy of 150 micrometers was installed on the Pie Town antenna. Testing of the antenna's RF performance has yet to be completed, but the initial results are encouraging.

Central Development Laboratory

With the completion of 33 production amplifiers during this quarter, the requirements for the new K-Band and Q-Band receivers are nearly done. These amplifiers now regularly incorporate at least one stage of Cryo-3 transistors and hold the world record for low noise. A build of 10 K-Band LNAs for the GBT is progressing with delivery scheduled for the next quarter. Progress was made in transferring amplifier design models to a modern commercial simulation program.

The ALMA Band 3 mixer (84-116 GHz) has achieved a noise temperature of about 17K DSB over a 6 GHz wide IF band. The ALMA Band 6 improved mixer (211-275 GHz) demonstrated a noise temperature of about 35K DSB over an 8 GHz wide IF band. Both of these devices now have set the standard for performance elsewhere in the world. Initial construction work was begun on the ALMA SIS mixer-preamp

and cartridge test systems; these will be dedicated to production testing. The mixer test Dewar has been fabricated in Green Bank, and now must be custom-fitted to the Sumitomo two-stage refrigerator which has been received. During this quarter a new method of mounting mixer chips in split block waveguide mounts has been developed, in order to simplify the assembly step which occasionally led to poor ground connections at the edges of the substrate.

More tightly integrated local oscillator driver chains for the ALMA LO were demonstrated, and the high frequency multipliers were successfully tested in a cryogenic environment. Triplers from both Virginia Diodes, Inc, and the collaboration between JPL and the University of Michigan are being developed.

The last PCB layout for the two-antenna prototype ALMA correlator was completed, except for a test simulator card. System testing has progressed well with both station bins being fully populated. Some work on the design of a new filter card, enabling the baseline ALMA correlator to provide significantly improved spectral resolution, was done during the quarter.

The EVLA L-Band (1-2 GHz) feed horn, a compact corrugated horn with a sinusoidal inside profile, was scaled to create a prototype for C-Band(4-8 GHz). The feed horn, machined from an aluminum casting, showed patterns in good agreement with theoretical expectations, though the cross-polarization is higher than desired in the upper edge of the band. Feeds for use in the band 68-92 GHz with the GBT were measured in an anechoic chamber with satisfactory results. Phase shifters for the band 26-40 GHz on the GBT have been fabricated.

Data Management

The second development cycle of the End-to-End (e2e) project continued, with emphasis of having designs and/or prototypes for all deliverables to a level of detail sufficient to allow definition of project scope and schedule. A calibrator tool has been developed, tested, and placed into use. An archive for VLA/VLBA is in development and is close to deployment. The physical archive now is expected to have all of the historic VLA data loaded by the end of May. Purchase of the hardware needed for the GBT archive is now proceeding, and some testing of the software on GBT data sets has been done.

On the technical side, a key strategic choice in the e2e project has been to try to align closely with the ALMA Computing IPT. A consequence would be that tools developed for ALMA, such as the simulator, could be adopted for e2e purposes. The implementation architecture for e2e is close to finalization. We expect to use Java/Oracle for processes such as proposal submission and handling, and AIPS++ for scientific processes such as pipeline reduction.

During this quarter an external technical review of the AIPS++ project was held. The review indicated that there were no fundamental flaws with the core or architecture, but found defects in process and management methodology. A proposed architecture change by the project was recognized as an important upgrade, and we were encouraged to proceed with it. Steps are being taken to address the other issues raised in the review.

AIPS++ single-dish staff have continued a close collaboration with GBT Operations, aimed at meeting the scientific and technical needs of telescope commissioning and data reduction. There are weekly meetings, and the on-site AIPS++ developer assists directly in user support. A number of user tutorials on single-dish capabilities have been conducted.

The Data Management group has been mandated to substantially complete the Common Computing Environment by the end of 2003. In support of this target, a more formal management structure, with requirements and progress reports, has been implemented; there has been a detailed identification of the tasks and resources; and the fraction of the time spent in this area by the system administration staff has been doubled. An important face-to-face workshop was held in Socorro in March, and was attended by all system administration staff.

Observatory-wide communications continue to be improved. A new intranet contract has been put into place that will allow the improvement of the service at a couple of the VLBA sites. The upgrade of network service to the VLBA Kitt Peak antenna should be complete next quarter. The fiber ring connecting the buildings in Green Bank has been upgraded, and network equipment will be installed to support the Green Bank Educational Center.

Education and Public Outreach

By the end of March 2003, the interior of the Green Bank Science Center, including the A/V systems, was complete, with only a punch list of items remaining. Exterior work such as sidewalks and landscaping, resumed with the return of warmer weather. The first installation of exhibits is scheduled to begin in April, and the center is scheduled to open Memorial Day weekend. Construction of the gift shop for the VLA Visitor Center has begun, with a target for completion in June.

The NRAO website has been extensively redesigned. It features four targeted lead pages, for the general public, for astronomers, for students and teachers, and for NRAO staff, and contains updated navigation tools and information areas, and second tier pages with the same format.

The five-year renewal proposal for Research Experience for Students (REU) and the Research Experience for Teachers (RET) has been informally approved. There will be three teachers in the program at NRAO this year, in addition to the usual complement of REU students. Proposals have recently been

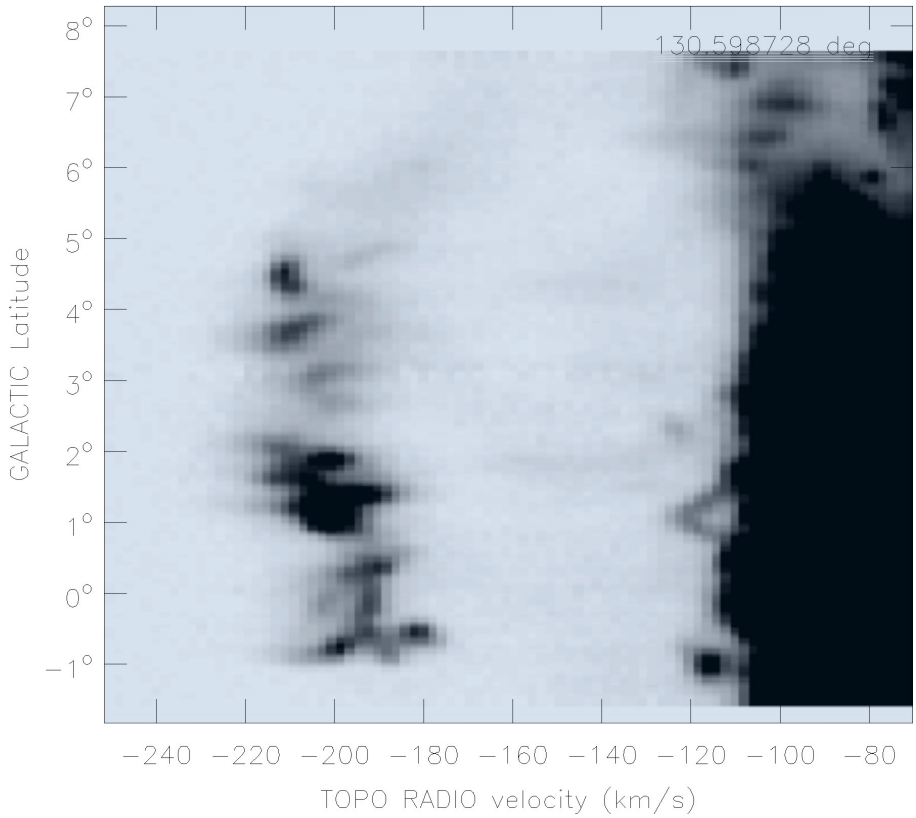
submitted seeking support for family weekend camps in New Mexico, and for presenting six Discover Academy programs for county middle school students in West Virginia.

NRAO was active at the Seattle AAS meeting with five press releases, and participation in three press conferences. EPO continued its efforts to improve the awareness of NRAO in West Virginia, Virginia, and New Mexico. Of particular interest was the display NRAO presented in the Rotunda of the New Mexico State Capitol during the annual Legislative session. This included a stand-alone display, a scale model of the VLA antenna and transporter, and a DVD video of a transporter moving an antenna. Brochures were distributed to legislators, staff and visitors, and NRAO staff visited with several of the legislators.

Green Bank

High Velocity Cloud Interacting with the Milky Way—GBT observations of HI emission from the high-velocity cloud Complex H give clear evidence that this cloud is interacting with the Milky Way, and is thus located somewhere within the halo of the Galaxy rather that at intergalactic distances. The main features of the HI kinematics are matched by a model in which Complex H is a satellite of the Milky Way in a bound, circular, retrograde orbit inclined to the Galactic plane at a distance of 33 kpc from the Galactic center. This model also reproduces the overall head-tail morphology of Complex H.

Investigator: F. J. Lockman (NRAO).

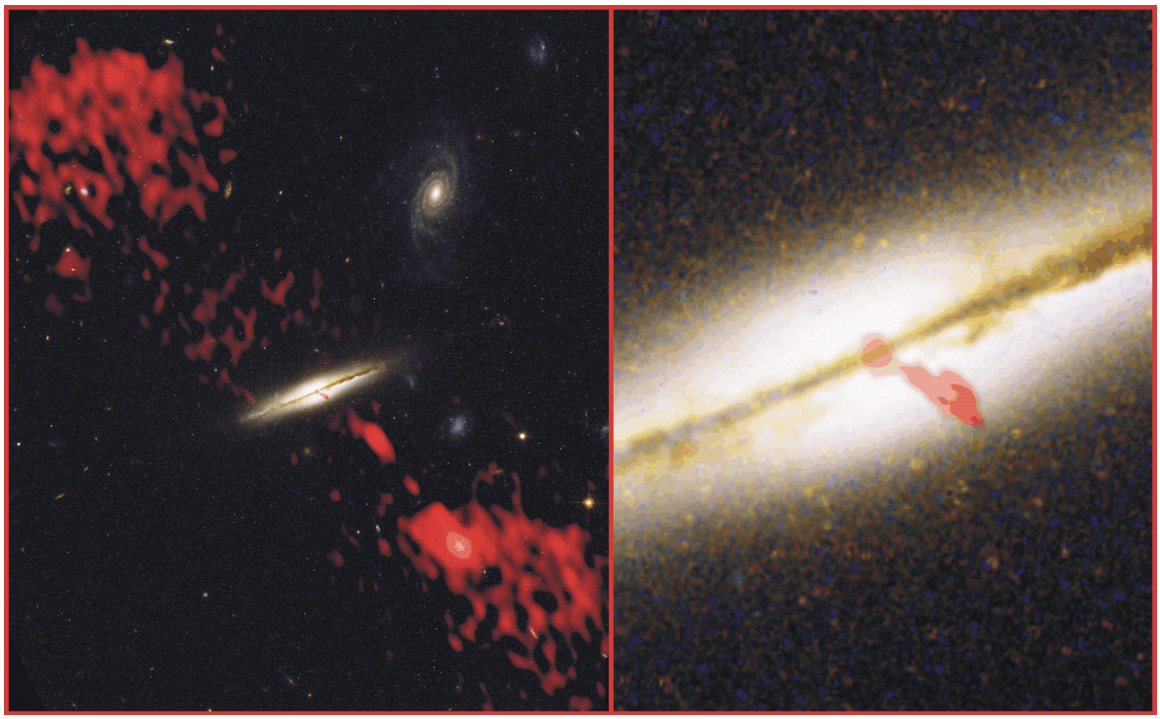


A velocity-latitude cut through Complex H (left side in figure) made from GBT data with an angular resolution of 9 arcmin. The "tail" at latitudes greater than 5 degrees is almost entirely broad-line gas while the bright "core" at lower latitudes contains many knots of narrower lines. There is diffuse HI emission at velocities between Complex H and the Galactic disk suggesting some material from the Complex has been decelerated by interaction with the Milky Way.

Very Large Array

First Jet-Producing Spiral Galaxy Discovered—Observations with the VLA, Hubble Space Telescope and the Gemini-South 8-meter telescope have revealed the first spiral galaxy known to be emitting giant radio jets. The galaxy, 0313-192, originally was found in a VLA survey of Abell clusters. Subsequent observations with the VLA and with the Apache Point 3.5-meter telescope suggested that the galaxy was a spiral. HST observations with the Advanced Camera for Surveys, installed in 2002, confirmed the galaxy's spiral nature. Further studies will focus on possible merger events and on the nature of the intracluster medium as explanations for how a jet can originate from a spiral.

Investigators: *W. Keel (Alabama), M. Ledlow (Gemini) and F. Owen (NRAO).*

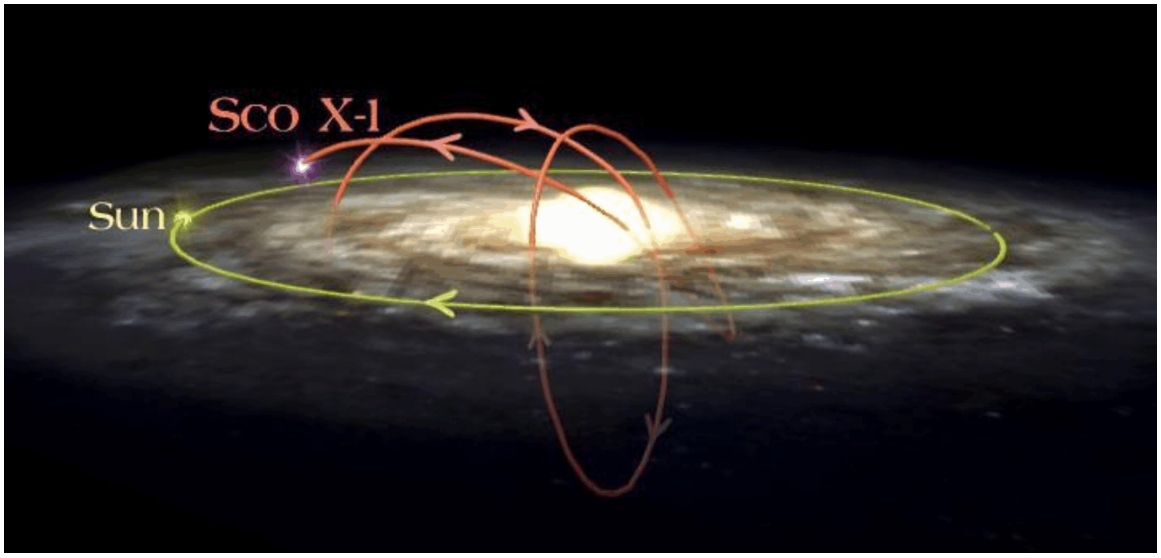


Composite images showing the galaxy 0313-192, the first spiral galaxy known to be producing a giant radio-emitting jet. At left is a wide view of 0313-192 and its surroundings, as seen with the Advanced Camera for Surveys of the NASA Hubble Space Telescope (HST). The radio-emitting jet, as seen with the Very Large Array (VLA) at a wavelength of 20 centimeters, is overlaid in red on the color image. At right is a close-up of the HST image, with another red overlay from a higher-resolution, 3-centimeter VLA image, showing the inner portion of the jet. The prominent spiral galaxy in the upper right of the large-scale image is not related to 0313-192. The complex vertical structure of the absorbing dust and the blue star-forming regions past a warp in the dust lane confirm the spiral nature of the galaxy, even though it is seen edge-on.

Very Long Baseline Array

Microquasar's Path Traced Back in Time—Using archival VLBA data along with optical data, researchers have reconstructed the Galactic orbital path of the microquasar Scorpius X-1 over the past 230 million years. It is the most accurate determination yet made of the path of an X-ray binary. The microquasar's orbit carries it far outside the Galaxy's plane, leading to the speculation that the neutron star originated in a globular cluster from which it later was ejected by gravitational interaction.

Investigators: *F. Mirabel (Institute for Astronomy and Space Physics of Argentian and French Atomic Energy Commission) and I. Rodrigues (French Atomic Energy Commission).*



Postulated path of Microquasar Scorpius X-1 (red) and Sun (yellow) through the Milky Way Galaxy for the past 230 million years.

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

The Bilateral ALMA Agreement between the National Science Foundation and the European Southern Observatory was signed on February 25, 2003, in Washington, D.C. This agreement formally establishes the ALMA project, defines the obligations of, and benefits to, the parties and forms the management and governance structures of the project. As specified by the agreement, the ALMA Board held its first meeting February 24-25, 2003. The current membership of the Board consists of:

North American Members	**European Members**
R. Dickman	P. van der Kruit
R. Giacconi	R. Booth
J. Hesser	C. Cesarsky
A. Sargent	R. Wade

At their first meeting the Board selected Massimo Tarenghi as ALMA Director effective at the end of Paul Vanden Bout's interim term April 1, 2003. Completion of the search for the remaining JAO key staff is expected over the succeeding few months.

Finally, the JAO formally submitted, and the Board approved, Version 1 of the ALMA Project Plan. The Project Plan defines the scope of the project, the high level science requirements, the management plan, the top level schedule, the cost, and the division of tasks. This document will be updated on a regular basis to reflect the current planning for the project. Changes to the plan will be submitted by the JAO to the Board for approval.

Delivery of the VertexRSI prototype antenna for the ALMA Project was completed in March. In spite of the delayed formal acceptance, significant progress has been made preparing the antenna for performance evaluation. All NRAO supplied test equipment, cable and cryogenics, have been installed on the antenna. Integration of the ALMA software to control the antenna is already well advanced. A trial "first light" observation at 3 mm and 1 mm has been completed using the Evaluation Receiver. Scheduled completion of the performance evaluation for the VertexRSI prototype antenna is unchanged. Evaluation of the antenna is now underway.

In order to facilitate the management of contracts and other business activities in Chile that are the responsibility of North America, NRAO is recruiting a Business Manager to be located in Santiago. The Santiago Business Manager will follow NRAO business policies and procedures under the direction of Bill Porter, the ALMA Business Manager.

Development activities for the Local Oscillator (LO) system have been reorganized. Portions of the LO system are the responsibility of both the Front End and Back End IPTs. In order to facilitate close interaction during the critical design and prototyping phase, LO development activities from both IPTs have been combined and will be coordinated by John Payne from the Systems Engineering IPT. Following development and prototyping, production of the resulting LO subsystems will revert to the existing IPT structure.

Expanded Very Large Array Highlights

Installation of the fiber optic cable at the VLA is progressing well and is ahead of schedule. A major milestone was achieved for the Canadian EVLA correlator project with the announcement on February 17 that the first increment of construction funding for the correlator is provided in the Canadian 2003 budget.

Expanded Very Large Array Progress

The EVLA milestones completed during the last quarter and those scheduled for completion during the next quarter are shown in the table below.

Milestones	Original Date	Revised Date	Date Completed
L301 12-20 GHz synthesizer prototype assembled	09/02/02		01/14/03
Start testing prototype MIB	07/15/02		01/20/03
Module assembly for sampler module	09/03/02		01/24/03
Ka-Band feed design	02/05/03		01/27/03
Deformatter board layout completed	01/31/03		01/31/03
L-Band feed scaled prototype fabricated	11/27/02		02/09/03
L351 512 MHz offset generator bench prototype assembled	07/12/02		02/14/03
T301 Prototype 4/P-Band converter assembled	08/16/02		02/17/03
Design for L-Band OMT prototype complete	04/29/02		03/03/03
Final engineering specification document, ver. 1	04/12/02		03/04/03
Finalize Q-Band receiver requirements	03/07/03		03/07/03
L352 ICD for MIB software	03/14/03		03/14/03
L352 RTP receiver & monitor bench prototype assembled	08/23/02		03/21/03
L301 12-20 GHz synthesizer prototype added to bench	03/14/03		03/24/03
RTOS on MIB prototype board	09/23/02		03/24/03
T302 L/S/C- band converter prototype assembled	10/31/02	04/01/03	
C-Band receiver design ready for drafting	02/05/03	04/04/03	
Finalize K-Band receiver requirements	02/28/03	04/07/03	

Milestones	Original Date	Revised Date	Date Completed
L302 ICD for MIB software	04/01/03	04/07/03	
L301 ICD for MIB software	04/08/03		
Start Antenna Outfitting	04/14/03	04/09/03	
L350 ICDs due for MIB software	11/22/02	04/18/03	
L305 Antenna reference generator/distributor bench prototype	12/13/02	04/18/03	
L350 Central reference generator prototype assembled	09/13/02	04/18/03	
L302 10.8-14.8 GHz synthesizer prototype assembled	10/04/02	04/23/03	
Ka-Band feed prototype drawings available	04/24/03		
L354 Central reference distributor bench prototype assembled	01/17/03	05/02/03	
L-Band receiver design completed	05/02/03		
L302 10.8-14.8 GHz synthesizer prototype added to bench	04/07/03	05/07/03	
Ka-Band receiver design completed	02/05/03	05/08/03	
L302 ICD for MIB software	05/14/03		
T303 U/X- band converter prototype assembled	05/23/03		
Design for C-Band OMT prototype	04/29/02	06/02/03	
Complete hardware bench integration	03/03/03	06/04/03	
Deformatter assembled for test antenna	03/07/03	06/30/03	
Archive ready for test antenna	06/30/03	06/30/03	
Alpha testing of the correlator backend	06/30/03	06/30/03	
West arm trenching of fiber cable completed	07/16/03		

In the electronics area prototyping and testing of all modules continued with prototypes of a number of modules being delivered during the quarter. Testing of prototype module containers showed good RFI shielding performance. Selection of connectors for the modules was completed and purchases initiated. Purchases of the high quality RFI shielded racks required for the Test Antenna were made. Testing of a scale model of the L-Band feed was performed. Test results showed satisfactory radiation patterns and return loss with an adjustment required to the horn mode generator to improve cross polarization performance at the band edges.

Excellent progress was made on the installation of fiber optic cable on the west arm of the VLA with cable to AW8, the second to last station on the arm, by the end of the quarter. This work is now well ahead of schedule. When the west arm is completed, installation will begin on the east arm. Permits for boring under highway 52 on the east arm have been obtained and boring will be done in the next quarter.

In the antenna area, preparations for the EVLA test antenna are being made. The Feed Cone is ready for installation. The prototype AZ cable wrap, which will carry antenna fiber transmission lines, is being tested in Antenna 6. The machine for making L, S and C-Band feed rings is complete. The machine shop is making C-Band Feed assembly fixture parts that hold components in place for fiberglassing. Design work for the L-Band, G& H racks, and L-Band OMT continues. ES Drafting is doing 3-D modeling of L-Band OMT parts for possible casting of the L-Band OMT parts.

In the correlator area, a major milestone was achieved on February 17 with the announcement by the Canadian Minister of Finance that the first increment of funding for the construction of the correlator is included in the 2003 Canadian budget. This means that the EVLA Project can rely on its Canadian partner to deliver the correlator. Since the budget announcement, the group at Herzberg Institute for Astrophysics (HIA) has filled its open personnel positions, including a software engineer and an assistant to the Project Manager, who will track project schedule and budget. The technical development of the correlator design is on schedule for testing a prototype correlator subset at the VLA in 2005. A progress review meeting between NRAO and HIA personnel was held at Penticton during the quarter.

The primary focus of the Monitor and Control (M/C) Group during the reporting period was continued work on the Module Interface Board (MIB) which is the interface between the M/C network and the individual electronic modules that are to be monitored and controlled. The first MIBs were completed and tested. The real time operating system was successfully installed and communication between the MIB and its Ethernet communication link was established.

The principal activity in the area of Data Management was the generation of detailed requirements documents for the operations and engineering interfaces to the data management software. Work continued on those elements of the End-to-End Project required for the EVLA.

Green Bank Technical Highlights

In March, first engineering checkouts of the 40-50 GHz (Q-Band) receiver were performed. This is the highest frequency at which the GBT has been operated. Initial results from both the antenna and the receiver were very promising. The active surface was utilized and yielded an aperture efficiency at 43 GHz of ~35%, consistent with an RMS surface of about 450 μm. The beam shapes were also quite good, with diffraction sidelobes below 20 dB. Spectral line observations of both thermal and maser SiO were successful. Commissioning and first astronomy will be completed in the autumn when high frequency observing conditions return.

GBT Antenna & Operations

Milestone	Original Deadline	Revised Deadline	Date Completed
Development of structural inspection plan for the GBT	07/30/01	01/31/03	1/31/03
Repair bowed GBT BUS member	09/01/02	02/28/03	3/07/03
Inspection of GBT welds/structure	06/30/02	09/30/03	
Continue site access improvements	12/31/02	deferred	
Cracked wear plate replacement	03/15/03	04/9/03	
Track retrofit shop weld demonstration	04/30/03		
Azimuth track trial retrofit field weld	06/10/03		

GBT Electronics

Milestone	Original Deadline	Revised Deadline	Date Completed
K Band receiver upgrade	09/30/03		
Spectrometer sampler rework	01/30/03	05/30/03	
Spectrometer Spigot card completion	02/28/03	05/30/03	
X Band receiver upgrade	01/30/03	05/01/03	
C Band receiver upgrade	02/28/03	04/15/03	

GBT Mechanical Engineering and Central Instrument Shop Work

Milestone	Original Deadline	Revised Deadline	Date Completed
EVLA L band Feed	08/30/02	02/13/03	02/03/03
ALMA Dewar Vessel and Heat Shields	04/01/03		02/15/03
K band OMT's for GBT & VLA (10)	06/02/03		
Q band feeds for VLA (2)	05/30/03		
Ka band feed for GB (Re-designed)	05/30/03		

GBT Software and Computing

Milestone	Original Deadline	Revised Deadline	Date Completed
Configurator V1.3: K and Ku band, multi-IF, direct command line access	03/12/03		02/24/03
Visiting observers infrastructure & facilities	06/30/01	8/31/03	
Project Office Rollout	01/31/03		03/31/03
Integration of AIPS++ group into Project Office	03/31/03		03/31/03
M&C V3.10: Dual DCR data collection Spectrometer Improvements	01/15/03		01-16-03
M&C V3.11: Active Surface, Antenna Improvements, Spectrometer Improvements	02/12/03		02/24/03
M&C V3.12: Active Surface, Multi-IF, Q-Band receiver checkout	03/12/03		03/12/03
1st Use of Project Office for Development Cycle Planning	04/23/03		
Institute Software Customer Satisfaction Surveys	06/30/03		

Milestone	Original Deadline	Revised Deadline	Date Completed
M&C v3.13 -Active Surface Improvements Phase 2 (Add new samplers, Enforce splitting of actuator commands) -Spectrometer Improvements Phase 6 (Reliability Improvements, Port to Linux) -Ease of Use Initiative Support (At least 3 MRs TBD)	04/23/03		
EMS v1.0 -Support for Trilateration Experiment -Data Capture and Playback from Laser Rangefinders -Matlab Interface -Database Interface	05/16/03		
M&C v3.14 -Temperature Monitoring Manager -Active Surface/Antenna Issues in support of PTCS (At least 2 MRs TBD) -Ease of Use Initiative Support (At least 3 MRs TBD)	06/04/03		
Complete Linux Migration Project Charter	05/31/03		

GBT Projects

Milestone	Original Deadline	Revised Deadline	Date Completed
PTCS: LRF calibration problem resolved	01/31/03	05/16/03	
PTCS: First draft high-level system architecture	01/31/03		01/22/03
PTCS: Active Surface code review complete	02/28/03		03/11/03
PTCS: EMS algorithm development platform	03/31/03		03/31/03
PTCS: Ready for initial design review	03/31/03		03/28/03
Antenna temperature sensor initial operating	06/04/03		
PTCS : In-progress review	10/06/03		

Astronomy Education Center Project

Milestone	Original Deadline	Revised Deadline	Date Completed
AEC main building construction complete	10/15/02	05/15/03	
AEC dedication	05/26/03	08/29/03	
AEC dormitory construction complete	07/18/03		

GBT Commissioning and Observing Activities

In the past quarter, we completed commissioning of the K-Band (18-26.5 GHz) systems, including both receiver, antenna, and observing mode tests. The receiver has been used in both its upper (22-26.5 GHz) and lower (18-22 GHz) frequency bands. The receiver is working well. The receiver temperatures are higher in the upper frequency band as that band utilizes an older generation of low noise amplifiers. We plan to replace these amplifiers this summer with the newer generation amplifiers developed and built at the Central Development Laboratory. The beam-switched observing mode was specified, tested, and put into regular use. This mode is utilized for point-source observations such as water maser or red-shifted galaxy observations. The active surface was also tested further and is in routine use at frequencies of 8 GHz and above.

More than 20 auto-correlation modes of the GBT Spectrometer are now available, including bandwidth modes at 12.5, 50, 200, and 800 MHz, and some of the multi-bank modes that utilize all four digital quadrants of the Spectrometer. Much progress has been made in implementing new modes and in improving the performance of the Spectrometer, but considerable work remains. The Spectrometer still suffers from some hardware reliability problems, and there are a number of modes yet to be implemented and released for use, including the cross-correlation and pulsar timing modes. The pulsar spigot card mode, in which the Spectrometer dumps data very rapidly into an acquisition system developed at Caltech is under test and may be released for "expert only" astronomical use in the next quarter.

The Q-Band (40-50 GHz) receiver was installed in March for initial engineering checkouts. The objective of these tests was to determine if both the receiver and antenna were performing as expected, and if there were any engineering issues that needed to be addressed over the summer. Astronomical commissioning and first science use of this system will occur in the autumn. The results of these tests were quite positive. The receiver appeared to work well, the aperture efficiency of the dish was ~35% (consistent with expectations and extrapolations from lower frequency), and the beam shapes were good. There were no diffraction sidelobes above 20 dB. There is a low shoulder on the main beam that is consistent with some astigmatism, but that can most likely be corrected by changes in the active surface profile. A few astronomical observations were made, including observations of thermal and maser SiO emission, and were successful.

Basic commissioning of the GBT is nearly finished. Most systems are in place, tested, and available for astronomical use at frequencies through 26 GHz. There is still considerable work remaining in terms of enhancements and bug fixes, which are being addressed on a priority basis. Items in this category include easier configuration of the system, resolution of a hundred or more software bugs, spectral baseline improvements, Spectrometer reliability improvements, and completion of advanced observing modes of the Spectrometer, as described above. Phase II (efficient operation to 50 GHz) commissioning should be completed in the autumn. Phase III (operation to 115 GHz) capability will be an on-going R&D project over the next two years.

Commissioning time is now being reduced in favor of scheduled astronomical observations. During the month of April, about 45% of total telescope time was scheduled for refereed, scientific programs. Through the summer, the majority of the commissioning needs will be devoted to observing program checkouts, continued tests on the Spectrometer, and spectral baseline work.

Azimuth Track

The work laid out in the January Quarterly Report is being executed. Our progress at the end of the first quarter is as follow:

Task 1. *Analytical Effort*. The measurement of the wheel load (and, therefore, the weight of the antenna) is essentially complete. Analysis of the data to remove the effects of the minute twisting of the structure during lifting, wind loads, etc., is in progress. Results are expected in the coming weeks. A work scope has been established for the analysis of the existing track, and is in the hands of Procurement. A contract will be awarded soon and work will commence on the finite element model. An experiment is in progress to determine non-uniform loads on the heads of the bolts that attach the wear plate to the base plate; the initial results were inconclusive and the experiment has been modified. It will be conducted again in the next few weeks. Structural analysis to determine the final geometry of the retrofit trial was performed in-house.

Task 2. *Retrofit of existing rail and data gathering*. Cracks in the surface of one wear plate were found in January. An exhaustive inspection of every wear plate revealed cracks in 12 others. A total of three plates, including the first, were deemed serious enough to warrant replacement as soon as possible, and operation restrictions put in place until they were. The first was replaced March 20, and the other two will be replaced by April 9 pending plate delivery. The fourth most seriously cracked plate has been targeted for the modification trial, and is being monitored in the mean time. No further propagation has been found. The causes of the cracking phenomena are yet to be determined. The wear plates were shimmed with the two methods recommended by the panel, and a comparison period is now in progress. A metallurgist has been consulted to help us with the failure analysis of the wear plates, and to support the trial modification of the track. A contract has been awarded for the proof-of-concept trial to a welding service and, pending a successful completion by early May, will be implemented for the trial section on the track in early June.

Task 3. *Development of New Rail Concepts*. Progress on this task has not started, due to the level of effort needed to support Tasks 1 and 2. It will begin in the next quarter.

Spectral Baseline Improvement Program

In the months of November 2002 through January 2003 we did a systematic study of the causes of spectral baseline distortions in the GBT. Various diagnostic spectral measurements were made to separate effects in different parts of the antenna and electronics. These included on-off observations with lateral displacements of the subreflector, on-off observations of strong continuum sources, and temporal stability of the spectra of noise generators substituted for the receiver output.

A number of weak, multi-path interferences were found in the antenna structure. Spillover noise enters the feed directly, as expected, but it also reflects from several places around the feed and is returned by reflections from the subreflector edge and the circumferential gaps between the main reflector panels. The extra reflections from the subreflector causes baseline ripples with periods of about 9 MHz and longer. The panel-gap reflections cause a ripple of about 1.6 MHz period. Frequency dependence of spillover noise normally cancels in total power on-off spectral line measurements, but it can be a problem in frequency switched data. The only obvious spectral distortion of continuum source on-off measurements is due to a standing wave between the inner edges of the subreflector and main reflector that produces a 2.3-MHz ripple period.

By far the largest distortion of (on-off)/off spectra of continuum sources was found to be due to a frequency dependence of the system temperature caused by reflections and resonances in the feed and waveguide structure of the GBT receivers. These effects have probably been present in receivers on older telescopes, but they are now more obvious with the much wider bandwidths of the GBT spectrometers. System temperature variations can be as large as 10% peak-to-peak across an 800 MHz bandpass. We have a tentative noise model for the reflections in the LNA/waveguide/feed interfaces which needs to be quantitatively verified. We are also investigating cavity resonances due to very low level leakage of power into the cryogenic dewar through the thermal-isolation gap in the waveguide. These resonances cause fine scale structure in the system temperature spectra with amplitudes less than about 1% in most cases. Efforts to improve the spectral characteristics of the GBT receivers will continue over the next couple of years, but there will always be some frequency dependence in the system noise that will need to be calibrated out with strong continuum source calibrations. Encouraging tests of the stability of such calibrations have been done, and further work will continue in this area.

Several spectral baseline stability problems were found in the IF electronics of the GBT. With 800 MHz bandwidths, small reflections in cables longer than about 50 centimeters become quite important. There are several cables in the signal path with lengths between 2 and 8 meters carrying signals between 1 and 6 GHz. The electrical lengths of these cables were found to be sufficiently temperature sensitive to cause time-dependent baseline ripples with periods between about 20 and 80 MHz. Cables with better length-vs-temperature characteristics are now under trial, and we will take measures to isolate these cables from variations in surrounding air temperature.

The laser driver modulators for the optical fiber IF links between the GBT receiver room and the laboratory were found to have a ripple in their gain as a function of frequency with a period of 2.4 MHz. This ripple occasionally shows up in spectra because of a slight instability in either its phase or amplitude. One

laser unit has been modified by the manufacturer with an anti-reflection coating on the modulator crystal, and the ripple amplitude was measured to be attenuated by 17 dB. Modifications of the other seven units are planned, pending budgetary considerations.

GBT Operations and Maintenance

Telescope Operations Activities

The majority of the field work to support the azimuth track activities came from the Telescope Operations Division, but required supplement from the Mechanical Division, the Plant Maintenance Division, and temporary hires. Routine work including preventive maintenance continued, with some delay due to these efforts and severe winter weather. These activities have now resumed. Activities during the late spring focus on preventative maintenance and preparation for major activities for the azimuth track inspection, as inspection of the critical members of the structure, and schedule painting of the structure.

A 20 foot "clamp" was placed on a bowed member in the reflector backup structure. The cause of the bowing was never determined, but did not appear to be caused by abnormal loads. The clamp was installed as a precautionary measure.

GBT Electronics

Digital Group

PTCS project work

Support was provided to the PTCS Project at about 4 FTE's. These support activities ranged from system design, electronics design, and experimental support to active surface development.

Spectrometer work

We continue to commission and repair the GBT spectrometer. We are plagued by failures in the Long Term Accumulator cards that are intermittent and/or slot dependent. We are also supporting the testing and verification of new modes. All the desired modes except Pulsar modes and Polarization modes have passed engineering checkout.

The Pulsar Spigot card testing was scheduled for one day per week, when it was possible for us to support the testing. Several of the spigot card modes were tested and more remain. We have experienced hardware problems with these cards as well. High-speed sampler modifications are underway to eliminate noise on the 1.6 GHz sampling clock. These are stalled due to a lack of technician time to work on them.

We are working on a design for a new test fixture to allow signals of known properties to be injected into the spectrometer for testing. Our current test fixture was cobbled together from junkbox parts, and has a few problems. The new test fixture will also support polarization cross product testing.

There are several intermittent and low-level defects in the auto-correlation function that is generated that are not well understood. The project scientist has recommended that we not pursue that at this time.

About 2.5 FTE have been spent on the spectrometer over this quarter. We expect this to continue for the rest of the year.

Antenna Support

The Digital group also provided engineering and technicians to the antenna electrical system and the antenna servo systems. This quarter about 2 FTE's were supplied.

Network and Infrastructure Support

Support was provided to maintain printers, install connectors on fiber optic cables, move computing equipment, etc. About 0.5 FTE is assigned to this task.

RFI Mitigation Support

The Digital Group supplied a technician, and considerable engineering help, to several large RFI problems. The GBT Servo System RFI project was completed this quarter, with the exceptions of RFI leakage in contractor-supplied equipment. We are also reworking the windows and doors in the Jansky Lab control rooms, which are of negligible utility at this time. 1.1 FTE was supplied for these tasks this quarter.

Microwave Group

GBT Baseline Improvement Project

The microwave group spent most of their time on the GBT Baseline Improvement Project. To date, most of the work has been in investigating the effects and deciding on a course of action. Some improvements in cables are being tested, and design studies are underway for some other effects. Amplifiers in the C- and X-Band receivers were replaced with new CDL designs with better stability and noise performance. This activity will continue into the next two quarters.

Antenna Range Support

The new indoor antenna range hardware was installed, and is being aligned and calibrated. It should be ready for use this quarter. The outdoor range is being maintained and used, and has a scheduled upgrade this summer as part of the Beam-Forming Array project.

PF 2 receiver

The receiver was completed and calibrated, and will be commissioned in July.

IF/LO systems

Problems with Gigatronics synthesizers were repaired this quarter. Some fans and some YIG oscillators failed. A method of increasing the power output was investigated. Work continued on a MMIC-based IF amplifier. An RTPM failure was also repaired.

Cryogenics

Routine support for GBT and CDL was supplied by the cryogenics team. Refrigerators in several receivers were rebuilt, compressors maintained, and repaired.

RFI Group

Jansky Lab Control Rooms

It was found that the shielding effectiveness of the GBT control room has deteriorated to less than half of its original specification. Corrosion of the window frames and the surrounding wallpaper had rendered the shielding ineffective. After fixing galvanic incompatibilities, the windows were reassembled. The doors are being repaired as of this writing, and should be finished next quarter. The remaining windows in the OVLBI control room will be finished in July.

Servo System RFI suppression

The RFI group contributed a technician to the RFI rework efforts. This work will be completed soon, depending on weather and access to the telescope.

ALMA Site Survey

The RFI group performed a site survey of the Chajnantor site. Memos regarding results are in the process of being written. Our equipment returned safely after a long journey through Customs.

RFI Testing

The RFI group provided testing to many internal GB projects. They also tested the new Astronomy Education and Visitor Center (AEVC) shielding, and performed much engineering and problem solving. The AEVC shielding, with the exception of some filters specified by others, is a success.

NRQZ Management

More license applications and site visits were processed this quarter, including a large application with many sites that required a site visit for each. A new employee was hired to take over the NRQZ management job while Wesley Sizemore assumes more technical duties.

RFI Group Management

The Group issued a policy document outlining RFI control measures for the Green Bank site, which is being reviewed by site management. In addition to this, a review of the past year's accomplishments and a forward look at the year to come was presented to the site management by Jeff Acree. This talk will also be given in Charlottesville and Green Bank for general audiences.

Metrology Group

Nearly all of the metrology group's effort was supplied for metrology related to the telescope. Bolt strain tests, telescope weighing, and other metrology tasks were undertaken. About 2 FTE's were supplied this quarter for antenna metrology work.

Minor parts of the three person group have been spent on the PTCS project. It is anticipated that the group will spend more of their time on PTCS next quarter.

GBT Mechanical Engineering Development

During the first quarter of 2003 the Mechanical Engineering Division been working with Telescope Operations and Lee King to implement the track modification trials outlined by the track review panel. The division has also been working with Operations and Metrology to weigh the telescope and measure the forces on the wear plate bolts. The GBT Structural Inspection Plan has been received and reviewed and accepted by both the Mechanical Engineering Division and the Operations Division and the contract has been closed out.

Green Bank Software Development and Computing

GBT Software Development

During this quarter the Software Development Division (SDD) focused on supporting the initial commissioning for the Q band receiver, active surface improvements and development of the Engineering Measurement System's first phase (all in support of the PTCS project), incremental improvements to the M&C system to support commissioning, and completing the overhaul of spectrometer software which alleviates reliability issues that have, in the past, negatively impacted observing, commissioning, and electronics work. The group continued to refine its internal methodology, the efficiency of its operations, and its relationship to and interoperability with the AIPS++ team. The Project Office web site was opened for NRAO use late in the quarter, and through its use during next quarter, will be refined to facilitate communication and project planning needs more smoothly.

The SDD continued regular, monthly releases of its key product, M&C, with v3.10 on January 16, 2003, v3.11 on February 24, 2003, and v3.12 on March 12, 2003. The following features were released: enabling simultaneous data collection from the DCR in addition to other backends to support baseline investigations, new stow procedure for the antenna, LO1 made to enable/disable Doppler shift calculations based on source velocity and velocity definition, feed defroster heater and blower control updated, Active Surface made to produce a FITS file, IF manager made to better handle all complete IF paths, user specifiable FEM for active surface, 100 ms actuator control loop closes in 100 ms, and approximately 15 improvements that together have made the spectrometer far more reliable than ever before. PTCS efforts were strongly focused this quarter. Active Surface improvements, selected from the Project Charter completed last quarter, were key parts of each release. These tasks will continue to be executed through the end of the third quarter in support of PTCS.

The SDD also completed a Project Charter for the Engineering Measurement System (EMS) in mid-January, and began work on a rapid development prototype for the EMS algorithm development platform. At the end of the 6 weeks allocated for initial development, the team had completed enough work to give a demonstration at the PTCS Conceptual Design Review in early April. The system is in limited use by engineers, and continued development is planned to make this an exploratory data analysis package for broader consumption. The suite of astronomical regression tests that was developed in the last quarter conjunction with the AIPS++ group was executed for all three releases this cycle, and some critical errors were corrected before software releases. The SDD will continue to use and refine this process throughout the year.

Software operations continued to evolve during this quarter. In the previous quarter, the SDD took steps to improving software quality and team effectiveness: software engineers initiated a process for developing and running unit tests, and identified a way to track the results from code re-factoring. Building upon the framework that was established during the third quarter of 2002, the SDD expanded its unit tests for the M&C product from 9 to 67 tests by the end of the fourth quarter of 2002, and to 250 by the end of this quarter. In Q4 2002, continuously re-factoring production code resulted in a reduction in build warnings of 80%, from 2480 to 474; eliminating these warnings suppresses the potential for unexpected system failures in the future. Throughout this quarter, this trend was continued. Build warnings were reduced from 474 to 59. The primary outcome of these re-factoring exercises is a more solid software product; this continuous improvement effort will continue throughout 2003 and into 2004. In support of the continued development of Project Office capabilities, the SDD began determining metrics to aid in the management of software development projects. For each development cycle, the velocity at which the group is accomplishing its commitments has been calculated. Although additional data need to be collected over the upcoming months to fully understand the value of the velocity metric, the ability of the SDD to deliver increased from 1.0 to 1.8 units of work accomplished per day over the duration of the quarter. During the next quarter, the SDD will work to keep its delivery velocity at or above 1.0. One of the group's primary goals for 2003 is to improve responsiveness to small, high impact requests. In this quarter, the SDD provided responses for all outstanding issues. In the next quarter, the group will work to dress and resolve as many of them as possible in a systematic fashion.

Green Bank Computing

This quarter has seen further reorganization of computing services at Green Bank. The aim of these changes has been to improve reliability of the telescope control systems. These changes have been successful and two more general computing machines have been removed from the list of dependencies. These two machines will shortly be reconfigured as hot spares for two critical machines in the telescope control network further boosting reliability.

The reorganization mentioned above has also led to improvements for the general computing with DHCP and DNS services being consolidated onto one machine. Along with other changes, this has allowed us to retire more Solaris machines. Other services, notably NIS automounter maps and NFS have been tidied up to improve speed and security. A number of applications have been upgraded including Mathematica, Adobe Acrobat, and Mozilla. Other improvements include moving all Linux file systems over to "ext3" and memory upgrades for power users.

Also new this quarter is virus checking of UNIX filesystems to complement that done on Windows machines. With the tighter coupling of UNIX and Windows systems such a step is necessary for more complete protection. The initial sweep detected several viruses hiding in our UNIX systems including one downloaded from Sun with its operating system patches. Several viruses were also detected in the central web cache which has led to the blocking of a few malicious web sites. Such viruses continue to appear and are dealt with as they arrive.

There have been some changes in the appearance and organization of our web presence this quarter with the roll out of the new NRAO "look." Green Bank's front page has been converted along with several other sections.

Eric Greisen (Socorro Operations) has created and will maintain an up-to-date AIPS installation. This was all accomplished remotely from Socorro.

A sysadmins workshop was held in Socorro in March which all members of the Computing Division attended. This was extremely productive, with all attendees coming away with a much clearer picture of how to proceed with and accelerate the Common Computing Environment project. One of the areas identified for improvement was our central documentation, so keep an eye on the "Gold Book" (http://www.nrao.edu/internal/doc/). Another result of the workshop was a timeline for the deployment of the NRAO Windows 2000 AD domain.

GBT Development Projects

PTCS

The PTCS Conceptual Design Review was held on April 8 and 9, and seemed very successful. Without wishing to prejudge the formal report, the review committee had a number of specific technical concerns, but seemed to feel that the basic approach proposed was acceptable. They do appear concerned

about the ambitious schedule, especially given the available resources. We will need to set "inchstones" as well as milestones, and work hard to achieve these. The formal committee report should be available in approximately two weeks. Apart from the review itself, considerable technical progress has been made over the last few weeks. R. Creager and P. Marganian have completed the first implementation of the EMS (which they demonstrated at the review with archive data). We plan to start real experiments with this within the next few weeks. J. Wray, J. D. Nelson and R. McCullough are making good progress on the temperature sensor system, which we hope will have initial operating capability by the beginning of June. C. Chandler has arrived from Socorro, and has already installed the OOF data reduction software. Initial observing tests will start this weekend.

Penn Array Receiver

Through the first three months of 2003, the University of Pennsylvania worked on finalizing the detailed design of the Penn Array Receiver. The cryogenic temperature monitor and control system was designed and built, allowing detailed characterization of the pulse tube cooler and sorption fridges. The optics design has been taken to a nearly final stage; an important step was determining that anti-reflective coating of quartz lenses for the re-imaging optics was possible, allowing their use instead of higher-loss HDPE. Extensive study of the ghosting, loading, diffraction, and other properties of the optics have been conducted. The receiver optics will accommodate a variety of array sizes and geometries. The transition-edge super-conductor recipe at Goddard is in the final stages of fine tuning based on detector parameters agreed upon in December of 2002 . Detector housings and thermal isolators have been designed and built, and a blackbody horn for future lab tests was also designed. The Green Bank Electronics Division assisted Penn in the preliminary stages of designing a package which would meet local RFI requirements. A CDR is planned for next quarter.

1 cm & 3 mm Receivers and Continuum Backend

Work on the 1 cm and 3 mm receivers has been temporarily suspended to give further engineering support to spectral baseline improvements and other projects. In January and February, Readhead's group at Caltech continued to make good progress on the design of the digital continuum backend for these receivers. There was excellent progress on the software interface to the backend with extensive input from the Green Bank Software Division. This resulted in an essentially final and well-documented communication protocol. Some progress was made on a detailed electronics design. Based on this, the Green Bank Electronics Division provided feedback on the electronic interfaces and RFI mitigation. Due to a personnel change at Caltech in March, the planned CDR for the Caltech Backend has been postponed. A revised time table will be determined shortly, but, due to changes in the 1 cm receiver timetable at Green Bank, the impact is not expected to be significant.

Mechanical Engineering and the NRAO Central Instrument Shop

This quarter the Central Instrument Shop completed the fabrication of the EVLA L-Band prototype and two K-Band Feeds for the VLA. The shop also fabricated a Dewar assembly and a 3 mm lens for ALMA. Work was started on ten K-Band OMTs for both the VLA and Green Bank and will be completed next quarter. The revised Ka-Band feeds for Green Bank and two Q-Band Feeds for the VLA are expected to be completed next quarter as well. The Central Instrument Shop has also worked with Operations to lay out and machine the holes in the replacement wear plates for the GBT.

VLA Highlights

In March 2003, the New Mexico Senate voted to pass House Joint Resolution #3, returning ownership of the VLA Visitor Center to the National Science Foundation (NSF). The center was built in 1983 using state funds and land donated to the state by the NSF. The state has been responsible for major repairs to the center, but NRAO has taken care of its day-to-day maintenance. Ownership of the center was transferred to the NSF so that the NRAO can make significant modifications to the building for its education and public outreach programs. Construction on an addition to the center has already begun (see figure below).

VLBA Highlights

The high frequency performance of the VLBA antennas is limited by surface imperfections in the antennas' subreflectors. A program to measure and resurface the subreflectors was initiated in late 2002. In February 2003, a spare subreflector that had been reshaped to a surface RMS of 150 microns was installed on the Pie Town antenna. Testing of the antenna's RF performance has yet to be completed, but initial results are encouraging.

Construction on the new addition to the VLA Visitor Center.

Subreflector installation at Pie Town.

Management and Scientific Services

Milestones	Original Date	Revised Date	Date Completed
VLA Public Tour	02/01/03		02/01/03
VLA/VLBA Proposal Deadline	02/03/03		02/03/03
VLA Skeptical Review Committee Meets	02/22/03		02/22/03
Jobserve Cookbook Revision	11/23/02	03/31/03	02/28/03
EVLA Completion Plan Science Case-Version 1	10/31/02	01/31/03	03/21/03
Iridium OH Filters Available for VLA Observers	02/28/03		03/28/03
VLA Public Tour	04/06/03		04/06/03
EVLA Completion Plan Draft Finished	03/31/03	04/07/03	
Complete Tests of Resurfaced Subreflector at Pie Town	05/15/03		
VLBI Calibration Transfer for 1 VLA Antenna	05/26/03		
Automated Monitoring of AIPS Software Downloads	06/30/02	05/31/03	
VLA/VLBA Proposal Deadline	06/02/03		
Begin Third Session of VLA-Pie Town Link Observing	06/10/03		
VLBA 10th Anniversary Symposium	06/30/03	06/12/03	
Summer Student Arrival Completed	06/20/03		
VLA Visitor Center Gift Shop Opening	02/28/03	06/30/03	
VLA Loses One Antenna as EVLA Prototype	06/30/03		
VLBA Automatic Release Implemented	07/15/03		
Modular Office Space Occupied	05/10/03	09/30/03	
VLA/VLBA Proposal Deadline	10/01/03		
VLA/VLBA Target of Opportunity Implementation	10/31/03	01/01/04	
Release frozen 31DEC03 AIPS version; begin 31DEC04	01/02/04		
Santa Fe Workshop on Radio/X-ray Connections	03/31/04		
Synthesis Imaging Summer School	006/30/04		

Electronics

Milestones	Original Deadline	Revised Deadline	Date Completed
VLA/VLBA Pie Town Link (LO/IF)			
Complete construction & checkout of spares	01/31/01	05/30/03	
Receivers (FE)			
Install 2nd prototype, LDPE L-Band window	01/15/03	05/30/03	Under test
Build and install one more 86 GHz receiver for a total of nine	12/30/02	09/30/03 Pending funding	
VLBA Improvements			
Design for servo system enhancements	02/15/03		02/15/03
Lightning Protection System (LPS) Improvements	05/30/03	Pending funding	
EVLA Related Tasks			
Operational bench integration of the IF data path	06/15/03		
Complete antenna outfitting	07/25/03		
Start 2nd antenna outfitting	12/15/03		

Engineering Services

Milestones	Original Date	Revised Date	Date Completed
Complete DnC array reconfiguration	01/17/03		01/08/03
Complete D array reconfiguration	02/07/03		02/04/03
Complete A array reconfiguration	05/30/03		
Mechanical Group			
Replace cooling fan for Transporter #2	01/25/03		01/25/03
Antenna #6 overhauled	02/12/03		02/12/03
Painted Transporter #1	02/15/03		02/15/03
Completed dummy feeds for EVLA	03/01/03		03/01/03
RFI boxes	03/05/03		03/05/03
Complete spare VLA FRM	03/05/03		03/05/03

Milestones	Original Date	Revised Date	Date Completed
Pie Town gearbox Az #2	03/12/03		03/12/03
Overhaul Truck #1 for Transporter #1	03/15/03		03/15/03
St. Croix maintenance visit	03/27/03		03/27/03
Antenna #22 overhaul	03/31/03		03/31/03
Resurface Pie Town subreflector	04/30/03		
Mauna Kea azimuth rail repair	06/16/03		
Kitt Peak maintenance visit	07/22/03		
Paint Transporter #2	07/31/03		
North Liberty maintenance visit	08/18/03		
Antenna #15 azimuth bearing change	09/01/03		
Electrical Group			
Visitor Center power modifications	03/03/03		03/03/03
Uninterrupted power supply preventive maintenance	03/11/03		03/11/03
ALMA Japanese foundation power and fiber	05/30/03		03/18/03
ALMA European foundation power and fiber	03/30/03		03/24/03
Prototype VLBA tachometer	12/31/02	03/31/03	03/31/03
High Voltage Switch replacement	04/05/03		04/05/03
Transformer preventive maintenance	05/12/03		
Site & Wye Group			
Complete track repairs between BN6-AN5*	12/31/02	04/18/03	
Complete finish grade at ALMA Site	02/28/03		03/18/03
ES Engineering Group			
VLBA subreflector painting	12/31/02	01/30/03	01/30/03
VLBA subreflector installation at Pie Town	02/28/03		02/11/03

*Track repairs between BN6 and AN5 were delayed due to equipment failures.

Milestones	Original Date	Revised Date	Date Completed
EVLA Related Tasks			
EVLA feed horn assembly structure	03/31/03	04/30/03	
EVLA cable wrap	03/31/03		03/31/03
EVLA antenna outfitting	04/14/03		
Complete feed horn ring machine	02/28/03		02/28/03
Build two feed housings	02/28/03	04/30/03	

Time constraints prevented the completion of the second feed housing and the EVLA feed horn assembly structure.

The EVLA fiber burial on the west arm has progressed beyond AW8. Once the west arm is complete, the east arm will follow. Permits for boring under highway 52 on the east arm have been obtained and boring will be done in the next quarter.

Preparations for the EVLA test antenna are being made. The Feed Cone is ready for installation. The prototype AZ cable wrap, which will carry antenna fiber transmission lines, is being tested in Antenna 6. The machine for making L-, S- and C-Band feed rings is complete. The machine shop is making C-Band Feed assembly fixture parts that hold components in place for fiber glassing. Design work for the L-Band, G& H racks, and L-Band OMT continues. ES Drafting is doing 3-D modeling of L-Band OMT parts for possible casting of the L-Band OMT parts.

Computing Division

Milestones	Original Date	Revised Date	Date Completed
Activate Sophos Antivirus Gateway	10/31/02	01/10/03	01/10/03
Phase 1 AOC Rewire	03/31/03		01/15/03
Move VLA software to standard area	03/20/03		01/16/03
Mark VB software options document	01/31/03		01/31/03
Master Address Database	02/15/03		02/15/03
Upgrade Ftp Server	08/31/02	02/28/03	02/28/03*
VLBA MV 331 replacement evaluation	02/28/03		02/28/03
Ingres Conversion to Oracle	12/01/02	04/15/03	

Milestones	Original Date	Revised Date	Date Completed
NRAO-wide UID/GID normalization	04/30/03		
Radio Telescope at Visitors Center	11/01/02	05/01/03	
Transcribe VLA observer/system files	11/30/02	05/31/03	
Correlator Controller Support Line Mode	12/31/02	05/31/03	
Configure/Build Filehost Replacement	11/30/02	06/30/03	
VLBA Recorder Test Software	01/31/02	06/30/03**	
Plan Alternative to 9 track at VLA	03/31/02	06/30/03	
Establish NRAO-NM VPN capability	06/30/03		
Phase 2 AOC rewire	07/31/03		
Correlator Controller Bug Fixes	03/31/03	08/31/03	
Upgrade to RedHat 9.0	09/30/03		
Migration to Windows 2K domain	07/30/03	09/30/03	
Correlator Controller Integrate line/continuum	06/30/03	11/30/03	

* Superseded by new CCE targets
** Work done, required station software upgrade out of our control

Main reasons for not meeting or deferring targets are:

- Timeline modified due to recent Observatory-wide CCE (Common Computer Environment) agreements.
- Key aspects of work have to be done by staff not under control of the division.
- Late delivery of necessary parts—the slow economy has forced many companies to severely reduce inventories.

Major Developments

Milestones	Original Date	Revised Date	Date Completed
EVLA Related Tasks			
MIB->technical screens demo	01/01/03		01/01/03
Correlator Review Penticton	02/28/03		01/28/02
MIB Bootloader/Flashloader Application	01/17/03		02/01/03
MIB RTOS on prototype MIB board	01/31/03		03/10/03
Begin MIB/module integration H/W & S/W	02/24/03	04/07/03	
Fiber network connection MIB	04/15/03		
MIB Service port specification	04/24/03		
Rudimentary VLA M&C from CMP	03/31/03	04/30/03	
Config. EVLA computing infrastructure	03/31/03	04/30/03	
MIB service port specification doc	04/30/03		
MIB service port implementation	05/16/03		
High level EVLA M&C functional architecture	10/01/02	05/31/03	
MIB->technical screens	05/31/03		
Backend Alpha Version production code	06/27/03		
AMCS MIB Client-side S/W development	06/30/03		
Start new M&C system on test antenna	07/16/03		
New M&C system on test antenna ready for start of array tests	08/29/03		
Draft EVLA CMIB drive manual	09/30/03		
Draft Correlator M&C software design	02/28/03	09/30/03*	
Test antenna, array tests completed	11/24/03		
Re-evaluation and iteration upon M&C technical architecture	11/28/03		
Functional and technical overall EVLA M&C architecture/design	05/15/04		

*Rescheduled due to division of responsibilities change between DRAO/Penticton and NRAO.

AIPS

Key Developments

1. AIPS has been ported to the McIntosh OS/X operating system. At present, it appears that it is not making optimal use of the hardware, since the AIPSmark is lower than expected for the speed of the processor. Investigation of the tuning of the software for McIntosh has been halted, due to the lack of a modern McIntosh machine in the AOC.

2. Various bug-fixes and improvements have been made in the task CONFI, which is used to optimize array configurations. Many of the changes are associated with improvements in the algorithm that searches for the worst sidelobe and modifies the configuration to attempt to reduce that sidelobe.

3. UVSIM was modified to remove unused code, as well as changing the observation date and observing epoch to January 1, 2000. A true IAT time calculation was added based on the input coordinates of the observing array. The related task UVFIX was modified to make correct calculations for the GMRT, whose coordinate system (u,v,w) seems to be opposite from the VLA and other definitions. The investigation of the GMRT coordinate issue exposed various other bits of inefficient or erroneous code which were dealt with.

4. A number of small modifications were made to the VLBA data-calibration utilities, both for clarity and to correct small bugs.

5. Various changes were made to FILLM to make the reading of VLA data from disk a more robust process. Testing was done on modifications of the portions of FILLM that allow filling of data as it is observed. Significant improvements in robustness have been achieved, which will be released for general use early in the second quarter.

6. Investigation into improved smoothing, blanking, and interpolation of calibration tables was begun. The code and the techniques are rather complicated, so substantially revised tasks have not yet been entered into the system.

7. An investigation into possible improvements in phase calibration using externally supplied troposphere calibration was begun.

Goals for Second Quarter 2003

We anticipate a reduction in completion of new capabilities during the second quarter, due to a long vacation for the lead AIPS software developer. The following efforts are expected:

- Continue user support and bug fixes, as the major portion of AIPS effort.
- Add the more robust code for real-time filling of VLA data into the system.
- Continue investigation of improved smoothing and blanking in calibration.
- Continue the moderate-term project to explore improved troposphere calibration.
- Add T_{sys} values for a single VLA antenna into the calibration data supplied with VLBA correlator output.
- Test and enhance AIPS performance on McIntosh computers with the G4 processor (dependent on availability of a machine for testing).

Central Development Laboratory Highlights

With the completion of 33 production amplifiers during this quarter, the requirements for the new K- and Q-Band receivers for the EVLA are nearly done. Progress was made in transferring amplifier design models to a modern commercial simulation program.

The ALMA Band 3 mixer (84-116 GHz) was used to demonstrate world record bandwidth and noise temperature, about 17K DSB over a 6 GHz wide IF band. The ALMA Band 6 improved mixer (211-275 GHz) was used to demonstrate world record bandwidth and noise temperature, about 35K DSB over an 8 GHz wide IF band. Initial construction work was begun on the ALMA SIS mixer-preamp and cartridge test systems, which will be dedicated to production testing.

More tightly integrated local oscillator driver chains for the ALMA LO were demonstrated, and the high frequency multipliers were successfully tested in a cryogenic environment.

Integrated testing of the 2-antenna prototype ALMA correlator began.

Testing of prototype feeds for the GBT at 100 GHz and EVLA at L-Band began.

Major Developments

Milestones	Original Date	Revised Date	Date Completed
Amplifier Design & Development:			
1) Evaluation of TRW Cryo-3 devices from the point of noise, signal and dc properties at cryogenic temperatures	04/01/02	04/01/04	
2) Design/redesign of cryogenic amplifiers using Cryo-3 TRW devices for EVLA, VLBA, GBT and ALMA covering frequency range from 1 to 120 GHz	04/01/02	04/01/04	
1) Study use of overmoded w/g in LO transmission	03/16/01	2/28/03	2/28/03
2) Freeze Band 6 SIS mixer design	07/01/03		
Electromagnetic Support:			
1) G/T optimization of feed taper at 30 GHz	03/31/02	03/31/03	03/31/03
2) Feed pointing optimization of the VLA antenna	06/30/02	06/30/03	
3) Testing of EVLA L-Band prototype feed horn	03/31/03	05/01/03	
4) Testing of GBT W-Band feed horn	03/31/03		03/31/03
5) GBT L-Band pattern simulations	03/31/03	06/30/03	
6) Testing of GBT Ka-Band feed horn	06/30/03		
7) Testing of EVLA C-Band prototype feed horn	09/30/03		

Milestones	Original Date	Revised Date	Date Completed
ALMA Correlator:			
1) Develop FPGA designs for and test interface boards	09/30/02	03/31/03	03/31/03
2) Start PCB layout of quadrant control card	09/30/02	01/31/03	01/31/03
3) Start testing of prototype interface cards	12/31/02	01/31/03	01/31/03
4) Start PCB layout of the quadrant control card	12/01/02	03/31/03	02/28/03
5) Complete VLBA data recoding project	12/31/02	12/31/03	
6) Completion of the PCB layout and layout modification of all circuit cards required for the prototype correlator	03/31/03		03/31/03
7) Completion of the assembly of all circuit cards required for the prototype correlator	03/31/03		03/31/03
8) Substantial progress in system testing of the prototype correlator	03/31/03		03/31/03
9) Substantial progress in the development of software for the prototype correlator	03/31/03		03/31/03
10) Complete initial study of a new advanced digital filter for the ALMA correlator	03/31/03	06/30/03	
11) Test the fiber optic receiver card to filter card interface in the prototype system using a FO simulator card	06/30/03		
12) Perform first end-to-end test of the prototype system	06/30/03		
13) Advance the design of the new filter card	06/30/03		
14) Correct the station motherboard problem	06/30/03		
15) Improve the status of the ALMA correlator documentation	06/30/03		
ALMA LO Source:			
1) Delivery of the first LO driver	12/31/03		
2) Integration and test of bandpass filters and LO drivers	06/30/03		
3) Build and deliver improved LO to SRON	06/30/03		
4) Verify leveling using power amplifiers	06/30/03		
5) Complete testing of UMS wafer	06/30/03		
ALMA Frequency Multipliers:			
1) Band 7 frequency tripler evaluation	02/15/03		03/31/03
2) Band 9 frequency quintupler evaluation	03/31/03	06/30/03	
3) Fabrication and evaluation of micro-machined WR-10 and WR-03 waveguides and FGC structures	06/30/03		
4) Complete design and mask layout for MMIC tripler	09/30/03		
5) Complete fabrication of MMIC devices (at UM)	12/31/03		
6) Complete testing of MMIC tripler	03/31/04		

Amplifier Design and Development

A major effort was expended this quarter to implement the existing device models and designs into a modern, commercial CAD environment, Microwave Office. This implementation will facilitate the future design, modification, and presentation format of amplifier designs and simulations. Work continues on the evaluation of Cryo-3 devices and their application in designs covering the 1-2, 2-4, 4-8, 12-18, 40-50, and 75-118 GHz frequency ranges.

Amplifier Production

A total of 33 amplifiers was completed during the first quarter of 2003. These included 18 of the similar 3-13/8-18 GHz coaxial LNAs, 12 K-Band, 1 Ka-Band, and 2 Q-Band amplifiers. Production amplifiers now regularly incorporate at least one stage of Cryo-3 transistors and set world records for low noise. Socorro's major K- and Q-Band receiver projects have been largely completed at this point, and future production at those bands will establish a set of spare components and allow for possible replacement and modification of existing amplifiers to Cryo-3 transistors. A build of 10 K-Band LNAs for the GBT is progressing with delivery scheduled for the next quarter.

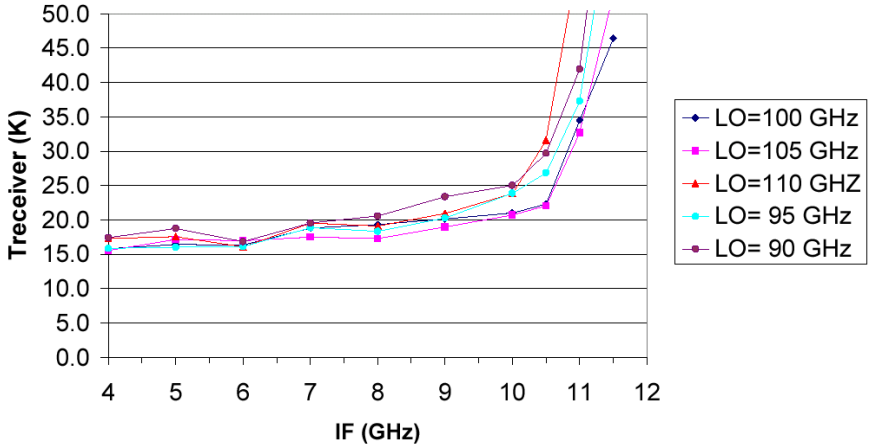
Other Projects

The amplifier group continues to support ALMA activity with assembly and wire-bonding services for both integrated SIS-IF amplifiers and various multiplier and MMIC development efforts. The plating lab continues to meet all requests as needed for both surface plating and electroforming of waveguide components.

Superconducting (SIS) Millimeter-Wave Mixer Development

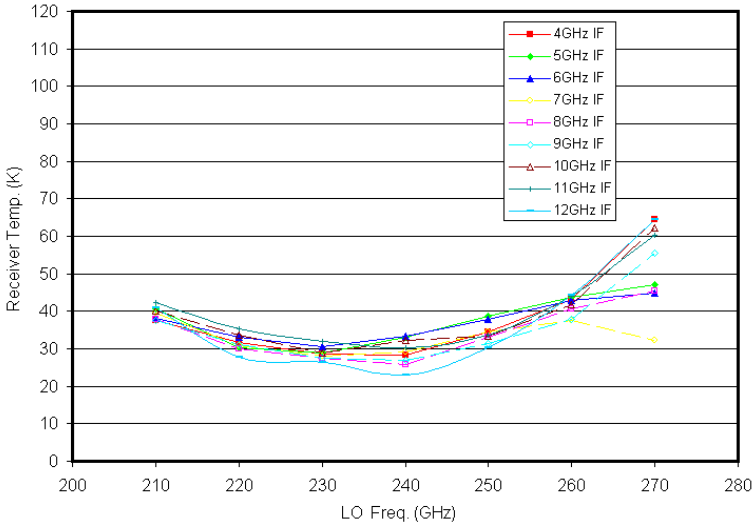
ALMA SIS Mixer Development

Band 3 (84-116 GHz) SIS Mixer-Preamp: Last quarter, we described initial measurements on a tunerless SIS mixer-preamp for ALMA Band 3. This quarter, the room temperature feed horn on the test Dewar was replaced with a cold (4 K) horn and other improvements were made to the test receiver to permit a more accurate evaluation. The figure below shows the DSB noise temperature of the receiver, measured in front of the vacuum window of the Dewar, as a function of intermediate frequency, with the LO frequency as parameter. The noise rise above ~10.5 GHz is partly caused by the non-optimum mixer-preamplifier coupling circuit and partly by the intrinsic preamplifier roll-off. With minor circuit modifications, the high IF performance will be improved. Even without such improvements, this mixer sets a world record for tunerless performance with a wideband IF.



DSB receiver noise temperature of NRAO/UVA Band 3 mixer-preamp.

Band 6 (211-275 GHz) Building Block SIS Mixer: Last quarter we received from UVA the first wafer of a newly designed single-ended SIS mixer intended as the building block mixer for Band 6. The new design has the following improvements: (i) it is optimized for the actual ALMA frequency band, which had not been decided at the time of the earlier design. (ii) a shorter RF choke circuit is used; this will improve operation with the wideband 4-12 GHz IF, and the shorter chip size results in more mixers per wafer. (iii) only four designs are included on the wafer (compared with 12 designs on earlier mask sets) which will result in a larger percentage of usable mixers per wafer. We have now tested the first of these mixers in a single-ended mixer block. The figure below shows the receiver noise temperature, measured outside the Dewar window, as a function of LO and intermediate frequencies (for reference, 3*hf/k = 33 K at 230 GHz). This sets a world record for tunerless performance and wideband IF.



DSB receiver noise temperature of NRAO/UVA Band 6 mixer-preamp.

Band 6 (211-275 GHz) Prototype Sideband-Separating SIS Mixer: This two-chip unbalanced sideband-separating design, integrated with a pair of 4-12 GHz IF preamps, is a prototype for Band 6. The mixer design is of the split-block type, using the waveguide quadrature hybrid described in ALMA Memo 343 and other waveguide elements described in ALMA Memo 381. The integral LO coupler (required in unbalanced mixers) is described in ALMA Memo 432. The first mixer is now being measured.

Band 6 (211-275 GHz) Final ALMA Sideband-Separating SIS Mixer: This will be the final design for Band 6. It is essentially the same as the above prototype but uses a physically smaller mixer block designed to mate with the OMT and feed horn in the limited space of the ALMA cartridge. It requires a smaller preamplifier than the current test mixers. The mixer block is being fabricated in the CDL machine shop. A prototype preamplifier with the smaller size has been successfully tested.

ALMA Mixer Test System: The mixer test Dewar has been fabricated in Green Bank and delivered to us. The Sumitomo two-stage refrigerator has also been received, but the locations of some of its mounting holes are not as shown in the manufacturer's drawings. This requires the Dewar to be sent back to Green Bank to be custom-fitted to the refrigerator. The existing measurement software is being ported from the legacy compiler, Visual Basic Version 6 (no longer supported by Microsoft) to Microsoft's newest compiler, Visual Basic "dot net." The translation to the newer Visual Basic compiler will simplify maintenance and allows the use of the latest features in the language. Porting of a database grid control, which has been customized to allow selection of mixer database records, is about 50% complete.

Mixer Fabrication Lab: During this quarter, we changed the method of mounting mixer chips in split-block waveguide mounts. To achieve low IF parasitic inductance and capacitance, all our current mixer chips require a DC ground connection at the edges of the substrate. In the past, this was done using soft gold crush wires which compressed between contact pads on the mixer substrate and shoulders in the mixer block as the two halves of the mixer block were brought together. This was a tricky assembly step, particularly if the mixer contained multiple mixer chips as in the case of our sideband-separating mixers; the gold wires could fall off the shoulders during assembly, or could twist so they were only clamped at one end. To overcome this, it would be possible to use conductive epoxy to glue the substrate into the mixer block without any crush wires, but we are concerned that differential expansion between the quartz substrate and brass block might fracture the glue joint on cooling. We have, therefore, adopted an approach using the crush wire as a pillow, attached with conductive epoxy to both the mixer block and the substrate.

ALMA 4-12 GHz IF Preamplifier Development

Type III Preamplifiers: A compact version of the 4-12 GHz preamplifier is required to fit the limited space in the cartridges. The components of the preamplifier are mounted on both sides of the housing, and the output connector is on the bottom. Instead of a DC bias connector on the amplifier housing, a short ribbon cable is used with a connector at its end. Like earlier versions, the compact preamplifier contains the bias-T for the SIS mixer, but to reduce its size, the discrete component bias circuit has been replaced with a commercially fabricated monolithic silicon RC network of our design. The first pair of these preamplifiers is now being assembled, and one has been successfully tested.

Type II Preamplifiers: Six of the larger Type II amplifiers have been fabricated for use in matched pairs with the prototype Band 6 sideband-separating mixers.

ALMA Band 6 Cartridge

Level-3 milestones for the Band 6 cartridge were defined and forwarded to the leader of the ALMA front end IPT. The Interface Control Document for software interfacing to the Band 6 cartridge was reviewed and updated this quarter. The cartridge wiring harness design was modified and finalized.

Three prototype feed horns were fabricated by Custom Microwave and have been sent to IRAM for return loss and beam pattern measurements.

Work continued on the cartridge internal design, thermally isolating LO waveguides, determination of cable loss and the resulting gain slope across the 4-12 GHz IF band.

The cartridge test Dewar and refrigerator have been received from Japan and load tests will be done shortly. The IF test plate and related test circuits have been designed and the components ordered.

Miscellaneous

Plating Tests: Before commencing production of ALMA RF components in quantity, it is necessary to evaluate the relative merits of different types of plating. Test blocks have been fabricated with ten-inch lengths of WR-10 and WR-3.7 waveguide, and these are now being measured using a WR-10 VNA and in front of a WR-3.7 SIS receiver. The results will be published in an ALMA memo.

Travel This Quarter

In February, E. Lauria attended a meeting at SRON to discuss (i) IF amplifier development for the European ALMA bands and (ii) modification of the SRON Band 9 mixer to allow the mixer-preamp to operate over the full 4-12 GHz IF band.

Publications & Memos

A. R. Kerr, L. Kozul and A. A. Marshall, "Recommendations for Flat and Anti-Cocking Waveguide Flanges," ALMA Memo 444, 6 January 2003.

Electromagnetic Support

EVLA

The L-Band (1-2 GHz) feed horn, which is a compact corrugated horn with a sinusoidal inside profile, was scaled and prototyped at C-Band (4-8 GHz). The feed horn was machined from aluminum casting. Far-field amplitude and phase patterns of this feed were measured in the principal planes, as well as the 45-

degree plane. There is an excellent match between the E- and H-plane patterns and good agreement with theory. At 6 GHz, the feed horn has a taper of –12 dB at the edge of the subreflector. Above 7.5 GHz, the cross-polarization level is worse than –16 dB. The phase center of this feed moves by 24″ in the 4-8 GHz range, which translates to 96″ for the full-size L-Band feed. The return loss of this feed horn measures better than –24.5 dB in the entire 4-8 GHz range.

Feeds and phase shifters for the ongoing K-Band (18-26 GHz) receivers were measured.

GBT

Feeds for the W-Band (68-92 GHZ) receiver were measured at the NASA/Goddard anechoic chamber. The taper at the edge of the subreflector measures between –12 and –13 dB. The return loss of this feed is better than –23 dB.

Phase shifters for the Ka-Band (26-40 GHz) receiver were fabricated and measured. The axial ratio is less than ± 1 dB in the entire range.

Computation of the far-out sidelobes of the GBT at 1.4 GHz is in progress.

Spectrometers/Correlators

ALMA Correlator

Last quarter's effort was focused mainly on completing the last PCB layouts, receiving and testing circuit cards for the two-antenna prototype ALMA correlator, and beginning system test of this system.

The last PCB layout or PCB layout modification required for the prototype system was completed in March with the single exception of a test simulator card. All circuit cards, with the exception of the Quadrant Control Card (QCC) and a small front panel data port interface card have now been assembled. All 18 assembled filter cards, all eight assembled station cards, and all 16 assembled interface cards have been successfully tested.

System testing has progressed well with both station bins being tested fully populated. One significant problem was discovered in the station bin where, due to a circuit board schematic error, a number of signal lines on the backplane were shorted together. This error will require correcting the station motherboard PCB layout and installing new motherboards. Otherwise, all signal runs, with the exception of the optic fiber-to-filter card interface (which has no driver), have been successfully tested.

Some work on the design of a new filter card, enabling the baseline ALMA correlator to provide significantly improved spectral resolution, was done during the quarter. However, the final design of this card has not been defined as yet.

Preliminary measurements of radio frequency interference generated by the correlator boards were done in the Green Bank anechoic chamber. Results are being analyzed.

A significant amount of test software was written to aid in system testing and in testing the interface cards.

No work on the VLBA data translation project was done during this quarter.

ALMA LO Source

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

A schedule and set of milestones were produced for the ALMA front-end LO work at the CDL demonstrating the plan for delivering the first of the LO drivers by the end of 2003.

MMIC multipliers and mixers from UMS have been delivered and undergone preliminary testing. Further testing, both on-wafer and in-fixture, is ongoing. The InP MMIC power amplifier wafer from HRL will be delivered in June 2003.

Microstrip coupled-line bandpass filters were designed and submitted for fabrication. These filters will be used at two points in the LO driver for suppression of unwanted YIG oscillator harmonics, which are thought to be adding sideband noise at the IF. In the next quarter, these will be integrated with the LO drivers and tested.

The Band 9 lab prototype LO was built and shipped to SRON. SRON performed both FTS and sideband noise measurements with this LO. This LO did not include the new quintupler design, as it has not been delivered yet, but included a quintupler originally designed for a 30% lower frequency band. This LO, therefore, worked well only from 630-675 GHz. However, over this limited range, the excess sideband noise over a Gunn-based LO was negligible. In the next quarter, we plan to build and deliver an improved LO using the new quintupler and interstage bandpass filters for sideband noise suppression. A paper concerning these results was submitted jointly with SRON to the European Microwave Conference.

The Band 7 lab prototype LO was built and used to test the new Band 7 integrated triplers. These tests were successful and showed greater then 400 uW over the entire band with the multiplier cold.

A conceptual design for the part of the cartridge outside the dewar containing the warm LO components, IF amplifiers, SIS mixer bias circuits, and appropriate heat sinks was produced, including three-dimensional models of the complete assembly. After several iterations, an acceptable design was achieved and was approved by the ALMA Front End IPT manager.

ALMA Frequency Multipliers

The purpose of this project is to develop millimeter- and submillimeter-wave frequency multipliers for use in laboratory experiments and receiver systems associated with ALMA. A series of multipliers using varactor and varistor circuits operating in the 50 to 950 GHz range are being developed.

Virginia Diodes, Inc., Frequency Multiplier Evaluation

The input and output waveguide assemblies required for the evaluation of Band 7 cold frequency triplers were fabricated by the CDL machine shop and subsequently integrated into the 77 K test dewar.

Extensive evaluation of the Band 7 cold frequency tripler prototypes (VDI 2.8x3 S41 and S46), including burn-in, output power performance evaluation, as well as temperature and RF cycling, was performed. The triplers were also mated with the Band 7 prototype LO driver, and the overall performance was found to be acceptable. (A detailed report will be released soon.)

Jeffrey Hesler of Virginia Diodes reported that the required rework was being performed on the Band 9 quintupler. Fabrication is scheduled to be completed by mid-April, after which the units will be assembled and delivered to NRAO for evaluation.

JPL/University of Michigan Collaboration

As stated in the previous quarterly report, the goal of this year's effort will be to get a frequency tripler with output in the WR-3 waveguide band. This will incorporate matching circuitry fabricated on micro-machined substrates. Toward that end, the micro-machined probe fabrication process needs to be extended and verified for its suitability for smaller structures. The frequency tripler will take the form of passive input/output matching circuitry (including waveguide probes) fabricated on thinned silicon with micro-machined pockets for incorporating GaAs-based diodes. It could also be realized as a single integrated GaAs circuit (this is to be determined). These circuits would then be seated into appropriately fabricated DRIE silicon blocks or metal housing assemblies.

Fabrication is scheduled to finish soon at UM for the following items which will then be evaluated at NRAO:

(i) micro-machined WR-3 waveguide (silicon);
(ii) FGC lines up to 325 GHz (silicon);
(iii) FGC line to WR-3 transition (silicon).

Custom Filters for LO Drivers

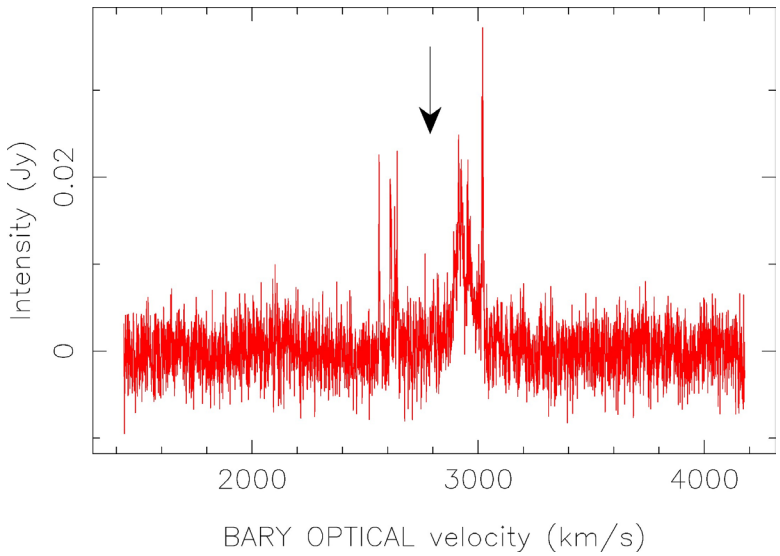
Various coupled microstrip filter designs (ten different designs in all) were completed and the layout drawings submitted to a commercial vendor for fabrication of these circuits. Delivery is scheduled in late April. These circuits will then be evaluated and incorporated into the various LO drivers under construction at the CDL.

Data Management Highlights

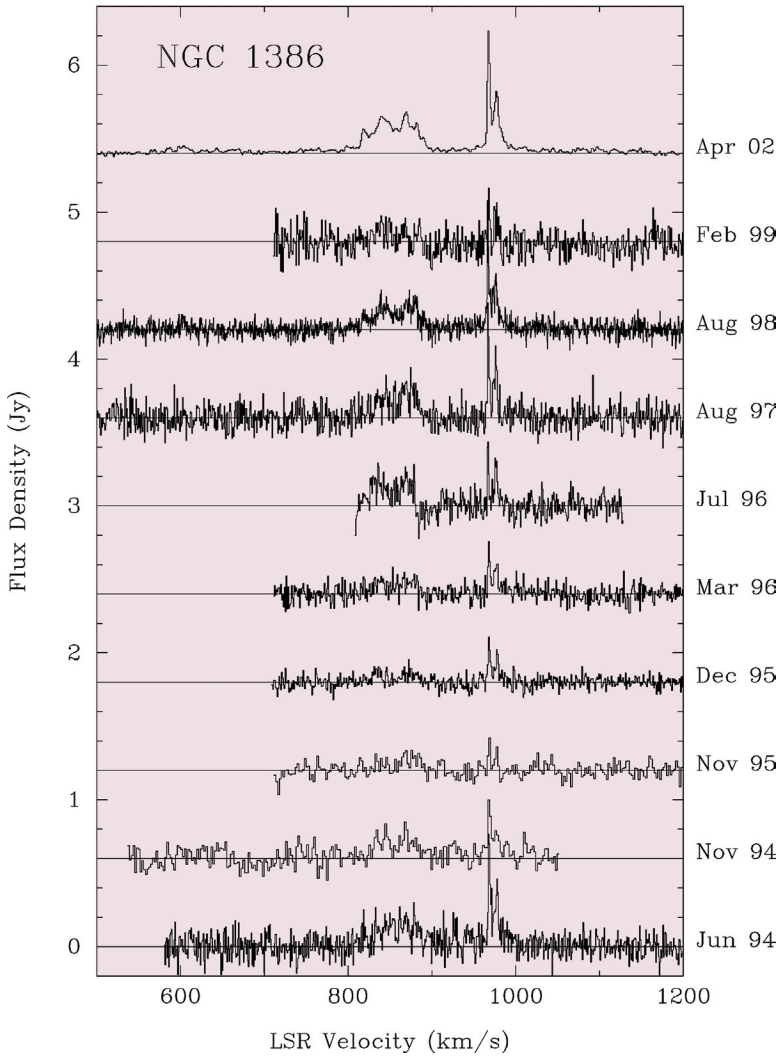
The data reduction system for the analysis of spectral line data from the GBT has been enhanced to include the calibration, averaging, removal of spectral baselines, scaling, smoothing and final display of the data. Two examples of this application are given below.

The first figure shows a maser discovered with the GBT in March 2003. The arrow indicates the systemic velocity of the galaxy. The object is a nearby Type 2 Active Galactic nucleus which had previously been unsuccessfully observed. This maser is one of five new masers discovered during a recent survey with the GBT.

The second figure shows a time sequence of spectra of the 22 GHz water maser seen in the nucleus of NGC 1386, a nearby Seyfert 2 galaxy. The top spectrum is a 10-minute scan taken with the GBT.The other scans are from the 140 Foot and Parkes telescopes, and required integrations of up to two hours. The study concentrates on the question of the origin of the maser emission in a thin, edge-on nuclear disk as has been found in NGC4258. The narrow components near 970 km/s would be analogous to *high-velocity* components originating at the edge of the disk, and seen tangentially. The clump of features near 830 km/s would be analogous to the *systemic* features seen along the line of sight to the black hole. The GBT spectrum shows blue-shifted features near 600 km/s for the first time. Measurement of the drift with time of the individual components of the complex at the systemic velocity offers the possibility of estimating the centripetal acceleration on the gas due to the central black hole.



A newly discovered 22 GHz maser in an AGN object of Type 2. The systemic velocity of the galaxy is indicated by the arrow.



A time sequence of spectra of the 22 GHz water maser seen in the nucleus of NGC 1386, a nearby Seyfert 2 galaxy. The top spectrum is a 10-minute scan taken with the GBT. The other scans are from the 140 Foot and Parkes telescopes, and required integrations of up to two hours.

e2e Project

Milestones	Original Deadline	Revised Deadline	Date Completed
Internal tests of VLA interim archive	01/15/02	05/15/03	
External tests of VLA interim archive	03/15/02	06/15/03	
Announce VLA interim archive server	06/01/02	07/01/03	
Purchase GBT archive hardware	09/15/01	06/01/03	
Initial tests of proposal toolkit	12/01/02	02/01/03	03/01/03
Deploy GBT server	01/15/03	06/01/03	
End of second development cycle	04/15/03	05/15/03	
e2e Advisory Group meeting	05/15/03	06/15/03	

The second development cycle of the e2e (End-to-End) project continued. The main goal of this development cycle is to ensure that by the end (May 2003) we have designs and/or prototypes for all deliverables to a level of detail sufficient to allow definition of project scope and schedule. Thus we are devoting two cycles of our spiral model to design and development. This amounts to about 15% of our total project effort. This fraction is generally believed to strike a suitable balance between D&D costs and low-term risk. In a slight change of emphasis, we have chosen to emphasize the production of useable prototypes and tools during this phase with the goal of ensuring close cooperation with the scientific staff early on. These include:

- A calibrator search tool has been developed, tested, accepted, and placed into use. Development was directed according to scientific requirements submitted to e2e by a group of scientists at the AOC. Testing was done by roughly the same group, and a moderate number of changes were implemented. Finally, the tool was officially accepted according to an acceptance document written by the DM project scientist (Dale Frail), agreed to by the scientific group, and then signed off by Jim Ulvestad (for the VLA/VLBA) and Tim Cornwell (for DM). We intend to follow this model for all e2e deliverables.

- A VLA/VLBA archive is in development and is close to deployment. The physical archive continues to grow as we transfer data from the original tapes to disk. At the current rate of tape loading (about 0.6TB per month), we expect to have loaded all of the historical VLA archive by May 2003. We will then switch to loading the VLBA archive and would expect to have loaded all of that by mid-late 2004. The user interface to the archive is under internal testing by scientists and data analysts and we expect to make it available to external users once that and some external testing is complete, probably within 2-3 months. Purchase of the GBT archive hardware was been delayed by the lack of an NRAO budget but is now proceeding. Testing of the software on GBT data sets has continued as projects are loaded into the archive at the AOC as they occur.

- A prototype proposal submission and handling system has been developed in Java using an Oracle database. We have now embarked upon initial user testing. We anticipate a substantial revision of the prototype following comments by testers.

- A number of radio source catalogs (NVSS, FIRST, and WENSS) have been placed online in the NRAO e2e archive. As part of our NSF-funded NVO development, we have made these catalogs accessible via the NVO conesearch protocol. This protocol allows access to the results of a query to the catalog concerning a given direction and search radius (a cone). The request is issued in an HTTP format to a specific URL. The answers are returned in the form of a VOTable as an XML-based format. AIPS++ can now issue and process these queries. For example, a user can ask for all sources overlapping a given image. Using AIPS++ tools, the result can be easily overlaid on an image or used to start an imaging or self-calibration process. The search can also be triggered from an HTML page at:

  http://www.aoc.nrao.edu/e2e/java/vocone.html

The prototypes described above have helped forge working relationships with the scientists interested in various application areas such as archiving. However, official requirements documents are still required. Progress here has not been as fast as we in e2e would like, mainly due to competition with other commitments for the scientists involved. Work on scientific requirements for the EVLA and GBT has been aided by the formation of Science Software Requirements groups for each. The first version of the EVLA SSR was delivered to e2e on Dec 9, 2002, and replies and requests for clarification issued are still proceeding. A first draft of the GBT SSR document is now under discussion by the GBT group. The incomplete status of these documents makes the planning process difficult and may delay the e2e costing phase.

On the technical side, a key strategic choice in e2e has been to try to align closely with the ALMA Computing IPT. DM/e2e is contracted to provide pipeline processing for ALMA, and AIPS++ is the baseline data reduction package for ALMA. Consequently, a close alignment seems to be well worthwhile if possible. As part of this process, e2e and AIPS++ staff members visited ESO/Garching on two occasions for technical and strategic discussions. Also, e2e and AIPS++ staff participated in the ALMA Preliminary Design Review held in Tucson March 2003. A design for the ALMA pipeline was reviewed at the PDR. In early December and late January, initial discussions were held between e2e and ALMA management concerning the adoption of the ALMA technical and functional architecture. Not only is this likely for e2e, but AIPS++ is considering adoption of the same framework, making interoperation of all three systems easy and lowering development costs. A consequence would be that tools developed for ALMA, such as the simulator, could be adopted for e2e purposes.

- The implementation architecture for e2e is also close to finalization. We expect to use Java/Oracle for business processes (such as proposal submission and handling), and AIPS++ for scientific processes such as pipeline reduction. This architecture makes optimum use of commercially available tools such as Java and Oracle, and NRAO-developed tools in AIPS++.

Technology Development

Milestone	Original Deadline	Revised Deadline	Date Completed
AIPS++ v1.8, Stable Snapshot III	01/15/03	01/31/03	01/31/03
AIPS++ External Review	020/1/03	03/07/03	03/07/03
AIPS++ v1.8, Stable Snapshot IV	02/15/03	2/28/03	02/28/03
ALMA AIPS++ tests - Phase II	02/28/03		02/28/03
ALMA AIPS++ tests - Phase III	03/15/03		03/15/03
AIPS++ PDR	03/19/03		03/19/03
AIPS++ Project Office Deployment	03/31/03		03/18/03
AIPS++ v1.8, End of Cycle	03/31/03	04/11/03	04/17/03
AIPS++ release v2.0	04/01/03	(cancelled)	-
AIPS++ v1.9, Development Cycle	06/01/03		
AIPS++/ACS Common Framework POC	10/01/03		

The DM Technology Development Division is concerned primarily with management of the AIPS++ project. This package is developed by a consortium of participating observatories, and is a flexible data reduction toolkit for analysis of radio astronomical data . The package is currently in an active integration phase, with increasing use at many sites. The current focus reflects the overall project status, and is concerned primarily with scientific completeness and enhancements in robustness and performance. The project planning is based closely on these priorities. The current release of AIPS++ is v1.7, and is available on CD-ROM or by network download. The current development cycle is divided into several "Stable Snapshots" which provide specific functionality/enhancements. A simple mechanism for updating to these installations is available and in use.

During this quarter, an external technical review of the project was held. The review indicated that there were no fundamental flaws with the core or architecture but found defects in process and management methodology. They recognized good progress in this area over the recent six months. They made recommendations to further strengthen the roles of the project management and the project scientist, to focus on use case driven development and in the short term (next 12 months) to concentrate on robustness and performance issues for existing applications. In addition, a proposed architecture change by the project was recognized as an important technology upgrade and recommended to proceed. The project agrees with these findings and is in the process of implementing them.

In addition to the overall priorities listed above, AIPS++ has retained a continuing focus this quarter on addressing time-critical needs for both ALMA and the GBT.

AIPS++ single-dish staff have continued a close collaboration with GBT Operations, aimed at meeting the scientific and technical needs of telescope commissioning. Following the GBT review in November 2002, this coordination has been improved and includes weekly meetings on status and close liaison on planning priorities and single-dish development. In addition, the on-site AIPS++ developer in Green Bank assists directly in user support and telescope commissioning activities. These activities have continued during this quarter. A number of user tutorials on single-dish capabilities have been conducted during this period, particularly focused on involving NRAO-CV staff in the GBT commissioning process.

AIPS++ has also retained a focus on meeting ALMA needs during this quarter. This has primarily concerned completion of Phases I, II, and III of the AIPS++-IRAM end-to-end test. The test reports were drafted/revised and presented by Robert Lucas (IRAM) to the ALMA PDR, at their meeting in March 2003. These tests have shown that algorithms and techniques from a different frequency regime (than what AIPS++ has been handling thus far) can be successfully implemented within the package. For Phase II, several data sets from IRAM were reduced within the package by outside users. A benchmarking program was also completed comparing performance in AIPS++ to other packages; these results were consistent with the project profiling. Recent progress in this area has been good, indicating no fundamental difficulties in matching the performance of existing packages, nor for scaling to the larger datasets anticipated for ALMA.

In general, this quarter has seen continued improvement in scientific completeness, usability and performance of the AIPS++ package. Our collaboration with in-house testers has continued at NRAO. Steve Myers, the Project Scientist, has initiated a user integration plan with appointed sub-system scientists for different areas of testing. The key focus for the future is to obtain use cases and prioritized requirements for key instruments, unifying the development and testing. The revised process further ensures that functionality is not released for use until it has passed acceptance criteria from non-project scientists.

Central Computing Services

Milestone	Original Deadline	Revised Deadline	Date Completed
Revise Security Policy	02/15/01	06/30/03	
Anti-virus email gateway deployment (NM)	09/30/02	01/31/03	01/13/03
VPN deployed (Charlottesville)	09/30/01	05/15/03	
VPN deployed (NM/Tuc)	06/30/03		
CCE survey of all NRAO computer users	01/31/03		01/31/03
CCE design (UNIX application co-ordination processes)	12/31/02	03/31/03	03/15/03
CCE design (core Windows applications)	03/31/03		03/15/03
CCE design (core UNIX applications)	03/31/03	04/30/03	
Begin W2K domain production client migration	01/31/02	08/31/03	
Begin evaluation of Windows XP	04/30/03		03/20/03
Issue revised Windows XP policy	06/30/03		

Milestone	Original Deadline	Revised Deadline	Date Completed
Deploy Proxy Server in Tucson	11/30/02	12/24/02	03/31/03
Populate OpenLDAP directory from HR info	03/18/03	03/18/03	03/18/03
Finalize Schema for OpenLDAP server	03/06/03	03/06/03	03/06/03
OpenLDAP server with Phone Book info running	04/15/03	04/29/03	
Create Queueing system HR -> OpenLDAP	11/19/02	03/18/03	02/28/03
Activate OpenLDAP server	02/18/03	02/18/03	02/18/03
Web Publication Policy	09/15/02	03/06/03	03/06/03
Main page, 2nd-tier page style revamp	11/30/02	01/31/03	01/31/03
Announce web proxy server at AOC	11/30/02	05/01/03	
Update web search engine to index pdf, ps	09/30/02	06/05/03	
Spare server: populate, activate one-way mirror	04/01/03	06/19/03	
Install proxy servers at VLA, IR, OIC	08/07/03		

Security

In the past quarter, the NRAO experienced no noteworthy computer security incidents, although the Distributed Denial-of-Service (DDOS) attack which was launched against the Charlottesville FTP server in spring 2002 continued at a very low level. Such attacks use numerous compromised systems as simple-minded automatic agents, unknown to their owners. The measures implemented several months ago remain effective at preserving the availability of this service for legitimate users.

All four identical anti-virus email gateway systems are now in full operation. The first such system, which receives the largest volume of incoming mail, has detected nearly 10,000 viruses since it was turned on at the end of August 2002. This demonstrates that the significant effort invested in this project has been worthwhile. Industry reports indicate that viral content in email continues to rise rapidly.

Virtual Private Networking (VPN) is needed for employees who are required to work frequently or for extended periods of time at non-NRAO locations, and to support telecommuters during construction at Edgemont Road in Charlottesville. VPN testing began in Charlottesville in late 2002, and has progressed to the point where we can now order identical hardware for Socorro. The Charlottesville box has been announced to local users; completion of this item is awaiting final consensus on the configuration, and appropriate documentation.

Due to staff commitment to higher-priority tasks, the Computing Security Policy revisions have yet to be done. The Policy needs revisions to accommodate VPN issues as well as special-purpose web servers and wireless networking security requirements; more specific policies on VPN and wireless deployment are under separate development.

Common Computing Environment (CCE)

The Data Management group has been given a mandate by the NRAO Director to substantially complete the CCE project by the end of 2003. Continued effort will be required after this time to ensure that the sites' environments do not diverge, and to integrate new technology and software; but within the year we intend to have all sites providing standard configuration of operating systems, network services, application software availability, and user interfaces. To meet this goal, we have made three significant changes in the way the project is managed:

- The use of more formal project management, such as project and technical requirements, assigned targets within a specified overall time line, and regular progress reports;
- Clear, detailed identification of the tasks and resources involved through the end of 2003; and
- Increasing the average fraction of time that the system administration staff commit to the CCE from 10% to 20%.

A very successful face-to-face workshop was held in Socorro March 13-15, with all NRAO system administration staff attending. During the workshop, a draft Project Requirements document was discussed and revised. In addition, both the UNIX and Windows project members identified, in considerable detail, the specific tasks that must be carried out to meet these requirements, as well as estimating the time required to complete them. This information has been used to create a time line for the project. Brief weekly reports are submitted by all project members, covering the targets for which they are responsible. We currently plan to hold a second workshop later in the year, to review overall progress and ensure that momentum and enthusiasm continue to be sustained.

In addition to the above steps, a questionnaire was sent to all NRAO computer users in January, as previously planned and about 200 responses were received. The goal of the questionnaire was to identify any problematic inter-site differences that may exist. The resulting information is also being used to determine the set of core applications that should be available on all desktop and public NRAO systems, as well as functionality required by laptop users.

Web/Information Infrastructure

- Web page redesign: NRAO's main "front" web page has been overhauled, and a set of four "focus" pages for different groups have been created: General Public, Astronomer, Teachers & Students, and NRAO Staff. Considerable work was done to retrofit the new look & feel of these pages to as many existing pages as possible, and this ongoing effort continues.
- Web Proxies or "Caches": In addition to the proxies in Green Bank and Charlottesville, additional proxy servers were configured in New Mexico and Tucson; the Tucson server is live while the Socorro server is pending integration of other, unrelated services.
- The draft NRAO Web Publications Policy was approved. This will be announced to the staff shortly.
- The "Phone Book" project - to create an LDAP-based directory - has made good progress. The directory server is active and running, and being populated from NRAO's Human Resources database on an as-needed basis. A queueing system to semi-automatically update the directory with

additions, deletions, and changes has been created, and a web based interface for the operator (to add required info not contained in the HR database such as phone number and room assignment) is under construction.

CV Computing

- The use of removable disk drives ("Firewire" and "USB-2") for both data interchange and backups has been investigated, and some limited use of this technology has commenced. A few staff members are now using such drives for routine backups of certain engineering and scientific datasets.
- Many Windows and UNIX based shared file systems continue to be migrated to the central storage facility (Network Appliance). In addition, routine backup to a tape library of the entire storage on the NetApp has commenced. The advantages of backups in a centralized paradigm are finally becoming apparent, as this backup regimen is vastly simpler than the failure-prone network-based distributed backup system employed previously.
- A spare or redundant server for CV's main mail, login, and general purpose UNIX server has been installed. Work has commenced on configuring it so it can take over with minimal work (5 minutes or less) in the event of catastrophic failure of the main server. With critical files already on the Network Appliance filer, such redundancy is made considerably easier.

Observatory-wide Communications

Milestones	Original Date	Revised Date	Date Completed
Replacement of Green Bank fiber ring	02/28/03	01/24/03	01/24/03
Renewal of Intranet contract	02/28/03		02/28/03
Upgrade network service to VLBA KP antenna	12/31/02	05/31/03	
Initial network to support the GBEC	05/31/03		
Complete network to support the GBEC	08/31/03		

After detailed price comparisons, the new Intranet contract was awarded to the same service provider (AT&T). However, a more cost-effective price structure was available to us through the Federal Telecommunication Service (FTS2001) of the General Services Administration (GSA). Continuing with the same carrier allowed us the huge advantage of continuing our Intranet operation with no service interruption. The new contract arrangement also has the advantage that we can improve the service at a couple of VLBA sites without increasing our costs. In addition, the contract allows for monthly billing and on-line service change orders, both of which will make the intranet simpler to manage.

After an unexpected delay in the delivery of the modems for the upgrade of the network service to the VLBA Kitt Peak antenna, they proved to be defective when installed and tested. Replacement equipment has been shipped to us. We now anticipate deployment in the next quarter.

The original fiber ring connecting the buildings in Green Bank was deployed in 1988 as a single 10 Mbps collision domain. Retaining the original fiber, the network has been upgraded to provide 100 Mbps backbone between the buildings supported by modern Ethernet switches.

In order to support the Green Bank Educational Center (GBEC), we will be installing network equipment to support classroom access to the Internet, live video casts, streaming video, etc. Procurement of the equipment will begin in the next quarter. We plan to have an initial network in place in May and to have fully configured service in place by the summer.

The video system is now routinely used to relay scientific and technical colloquia throughout the Observatory. To facilitate this, a new Polycom FX unit, which can also act as the hub for multi-site conferences, was acquired for the Charlottesville auditorium. The biggest remaining deficiency for interactive multi-site video between the auditoria is the auditorium sound systems. This will be addressed on a best-effort basis over the next few months.

Education and Public Outreach

Education and Public Outreach Highlights

Clearly the most recognizable activity associated with Education and Public Outreach was the storm of interest and inquiry generated by the AAS press conference and press release at the January 2003 AAS meeting in Seattle about a Measurement of the Speed of Gravity. Somewhat obscured by the discussion of the theoretical aspects of this presentation were the incredibly precise measurements achieved with the VLBA. Perhaps of more lasting significance for EPO operations was the switch on January 31, 2003, to the new NRAO web site with a more dynamic appearance and greater user friendliness.

Informal Education

A preliminary Informal Science Education grant proposal was prepared at Socorro, to create family astronomy weekend camps during three-day weekends during the year generated by Monday or Friday holidays. Another proposal from Green Bank to the Beaumont Foundation is to provide computers for the Green Bank Science Center computer lab to conduct six Discover Academy programs for county middle school students. Discover Academies will provide overnight immersive experiences which introduce students to engineering, technician work, astronomy, computer science, and drafting. EPO staff also prepared the EPO component of the EVLA Phase 2 proposal.

By the end of March 2003, the building interior, including A/V systems, was complete, with a punch list of items remaining. Exterior work, such as sidewalks and landscaping resumed with the return of warmer, drier weather. The first installation of exhibits is scheduled to begin about April. The center is on schedule to open Memorial Day weekend (May 24) with formal dedication to occur at a yet undetermined date during summer, likely at the end of summer when the student dorm is scheduled for completion. The New Mexico Legislature has approved returning the VLA Visitor Center back to NSF ownership. The measure passed both houses unanimously. Construction of the gift shop for the VLA Visitor Center has started with an indicated completion date early in June.

The redesign for the NRAO website went public soon after the start of the year. This redesign included a new home page with four audience specific (general public, astronomers, students and teachers, and NRAO staff) lead pages. These came with updated navigation tools and information areas, second tier level pages with the same format, and updated the "Server Side Includes," which are the automatic common elements to eventually be used on all of the NRAO's web pages. Additional refinements and enhancements will continue to be deployed.

During this period there were eleven tours for school/astronomy groups of the VLA and one of the AOC with a total of 400 guests. There was also one quarterly public tour at the VLA with 135 guests attending.

Formal Education

School visitors from Glenville State College, Glenelg High School, A. Linwood Holton Governor's School, Virginia Tech, and a fifth grade student and his father working on a school research project came for overnight/in-depth tours and observing with the 40 Foot Telescope at Green Bank. The Glenville visit was a Research Experience for Elementary/Secondary Education Students (3.5 days - conducted research projects on the 40 Foot, received lectures on Star Lab instruction, tours of the lab, and involved participation by four members of the NRAO staff). A presentation was given for Charlottesville area high school sophomores at a Careers Fair at Piedmont Virginia Community College.

Glenville State College Research Experience for Secondary Education Student visit.

The five-year renewal proposal for Research Experience for Students (REU) and the Research Experience for Teachers (RET) has been informally approved by the NSF at the level of 18 requested for the REU Program and at a level of 4 requested for the RETs (6 originally proposed). There will be two teachers at Green Bank and one at Socorro this summer. An NRAO/NASA joint astronomy workshop was funded under the auspices of the NASA Sun Earth Connection program. Twenty teachers from West Virginia, Virginia, and Maryland will be selected to participate in the one week workshop scheduled to take place in Green Bank in July.

Community Relations

In West Virginia, there were several organizational meetings with the fledgling Math/Science Alliance in the region. In the Socorro area, NRAO staff served as science fair judges for Socorro Middle and High schools, Magdalena Middle and High Schools, and Alamo Middle and High Schools. There was also a public lecture at the Socorro public library on the EVLA and a presentation at the Socorro middle school for two sixth grade classes. In Charlottesville, EPO conducted a one-day public mall display on the NRAO for National Engineers Week, presented to all grade levels (K-5) at Ruckersville Elementary in Greene County, and participated in the Virginia Discovery Museum of KidVention at Piedmont Virginia Community College with more than 2,000 children and adults in attendance.

Astronomy Community

In January, the NRAO made a strong showing at the AAS meeting in Seattle with five press releases (Clouds Dominate the Galactic Halo, Speed of Gravity Measurement, Giant Radio Jet from Spiral Galaxy, Star Ejected from Triple System, and Dwarf Galaxy Surprise), two NRAO-only press conferences and one NRAO result in big Milky Way press conference. One of the press conference/press releases on the speed of gravity produced worldwide publicity. Additional press releases after the AAS conference included a Microquasar's Path in the Milky Way, Signing of the ALMA Agreement, and Pulsar Bursts from Small Objects. The NRAO also had a presence in Denver for the AAAS meeting in February, which in turn led to a request to appear at the Science Safari mentioned in the next section. NRAO was granted permission to distribute our brochures at the Spitz Space Systems display during a one-day attendance at the National Science Teachers Association national meeting in Philadelphia in March.

Media Relations

One of our efforts is to improve awareness of NRAO in our prime states of West Virginia, Virginia, and New Mexico. In West Virginia, Intrawest, Snowshoe's parent company, held a one-day meeting at Green Bank, which included a guided tour of the new science center. As a direct result, Snowshoe plans to schedule a regular shuttle run from the resort to the science center. They also discussed the possibility of including special events at the center in to corporate meetings frequently held at Snowshoe. They thought the science center would add a unique element to these meetings. In Charlottesville, a contract was signed to begin a three-year commitment (beginning in April 2003) to post a back-lit educational display about the NRAO in the baggage claim area at the Charlottesville Albemarle Airport. Meanwhile, in New Mexico, we are pursing membership in the Albuquerque Convention and Visitors Bureau, which would entitle the NRAO to distribute our brochures at their airport information booth and at several prominent hotels in the city. We would also be included in the Bureau's touch screen displays located around the city.

On February 14, the NRAO presented a display in the Rotunda of the New Mexico State Capitol, during the annual Legislative session. This included a stand-alone informational display, a scale model of a VLA antenna and transporter, and a laptop showing a DVD video of a transporter moving an antenna. Brochures were distributed to legislators, staff, and visitors while NRAO staff visited with several legislators. That same day, through the sponsorship of NRAO's local Representative and Senator, NRAO calendars and luggage tags were delivered to the desk of each legislator in the State Senate and House chambers. Following a bill-signing and press conference in the Rotunda, the new Governor visited the NRAO display. In West Virginia, the EPO staff participated in Tourism Day at the West Virginia State Legislature.

The NRAO also had a display at the Department of Energy's Science Safari in Washington, D.C. Not only did this afford the NRAO the opportunity to present to about 400 District area school children in the Capitol Children's Museum, but also to present to about 200 people in the Rayburn House Office building, including staffers from Virginia Congressman Virgil Goode's Office, as well as from Michigan Congressman Vern Ehlers' office.

Telescope Usage

The NRAO telescopes were scheduled for research and maintenance during the first quarter of 2003 in the following manner. Note that time lost and actual observing for the arrays are computer at fractions of the total antenna arrays. For example, losing 27 VLA antennas for one hour counts as 1.0 hours of time lost, while losing one out of 10 VLBA antennas for one hour counts as 0.1 hours of time lost.

	VLA	VLBA	GBT
Scheduled Observing (hrs)	1566.60	1327.75	602.00
Scheduled Maintenance and Equipment Changes	225.30	237.00	465.00
Scheduled Tests and Calibration	358.00	224.30	1028.00
Time Lost	56.50	55.90	—
Actual Observing	1510.10	1271.85	701.00*

* Some test time was reallocated to astronomical observations.

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

No.	Observer(s)	Programs
BG134	Greenhill, L. J. (CfA) Kondratko, P.T. (Harvard U.) Lovell, J. (ATNFc/o COSSA) Kuiper, T. B. H. (JPL) Moran, J. M. (CfA) Jauncey, D. L. (ATNF)	Follow-up imaging of H_2O megamasers detected with the DSN II. 1.3 cm
GBT01A-014	Braatz, J. Greenhill, L. J. (CfA)	Detecting high-velocity masers to reveal nuclear disks in nearby AGN. 1.3 cm
GBT01A-054	Langston, G.. Bastian, T.	Search for cyclotron emission from known Extra-Solar Planets. 90 cm
GBT01A-057	Chatterjee, S. (Cornell U.) Cordes, J. (NAIC and Cornell U.) Lazio, T. J. W. (NRL) Goss, W. M. Fomalont, E. Benson, J. Stairs, I. (U. of British Columbia) Brisken, W. (Princeton U.) Thorsett, S. (UC, Santa Cruz)	Neutron star kinematics: VLB pulsar parallaxes with the GBT. 21 cm
GBT02A-008	Roberts, M. Maddalena, R. Haynes, M. (Cornell U.) Hogg, D.	A Study of the hydrogen reservoir surrounding galaxies. 21 cm
GBT02A-012	Minter, A. Balser, D.	Probing HI Structure On Sub-A.U. - A.U. Scales: Hydrodynamical or MHD Turbulence? 21 cm
GBT02A-031	Lockman, F. J.	Galactic HI mapping of X-Ray, UV, and optical deep fields. 21 cm
GBT02A-046	Braatz, J. Henkel, C. (MPIfR) Wilson, A. (U. of Maryland)	Monitoring a maser disk in Mrk 1419. 1.3 cm

GBT02A-049	Backer, D. (UC, Berkeley) Stairs, I. (U. of British Columbia) Nice, D. (Princeton U.) Lommen, (UC, Berkeley)	Exploration of millisecond pulsar timing stability. 11, 21, 70 cm
GBT02A-052	Stairs, I. (U. of British Columbia) Manchester, R. (ATNF) Lyne, A. G. (NRAL)	Continued multifrequency monitoring of a massive pulsars system. 11, 21, 50 cm
GBT02A-062	Camilo, F. (Columbia) Halpern, J. (Columbia) Stairs, I. (U. of British Columbia) Backer, D. (UC, Berkeley) Arzoumanian, Z. (NASA/GSFC)	Studying PSR J2229+6114: an Energetic Gamma-ray Emitting Young Pulsar. 11, 21 cm
GBT02A-065	Greenhill, L. (CfA) Kondratko, P. (Harvard U.) Braatz, J. Moran, J. (CfA)	Detection of AGN in apparently "normal" galaxies. 1.3 cm
GBT02B-013	Nolan, M. (Arecibo Observatory) Campbell, D. (Cornell U.) Howell, H. (Arecibo Black, G. Margot, J. (Caltech)	Target-of-Opportunity: Bistatic radar observations of near-Earth asteroids. 11 cm
GBT02B-018	Braatz, J. Henkel, C. (MPIfR) Greenhill, L. J. (CfA) Moran, J. M. (CfA) Wilson, A. S. (Maryland)	Using high-velocity masers to trace AGN accretion disks (H2O). 1.3 cm
GBT02B-019	Stairs, I. (U. of British Columbia) Ransom, S. (McGill) Kaspi, V. (McGill) Hessels, J. (McGill) Backer, D. (UC, Berkeley) Lorimer, D. (U. of Manchester)	Timing of newly discovered globular cluster pulsars. 21, 38 cm
GBT02B-021	Chandler, A. (Caltech) Jacoby, B. (Caltech) Anderson, (Caltech) Kulkarni, S. (Caltech) Prince, T. (Caltech) Backer, D. (UC, Berkeley)	Timing the six millisecond pulsars in M62. 21 cm

GBT02C-002	Carilli, C. Stocke, J. (Colorado) Menten, K. (MPIfR) Langston, G. Rector, T. Dwarakanath, K.	Redshifted HI 21 cm absorption toward red gravitational lenses (J0134-0931, J1004+1229). 38 cm
GBT02C-007	Dickey, J. (Minnesota) Kavars, D. (Minnesota) Lockman, F. J. Martin, P. (Toronto) McClure-Griffiths, N. (CSIRO) Rothwell, T. (U. of Toronto) Stil, (U. of Calgary) Taylor, R. (U. of Calgary)	A quick GBT HI survey of the inner galactic plane. 21 cm
GBT02C-023	Lockman, F. J.	A study of the HI clouds in the galactic halo. 21 cm
GBT02C-033	Liszt, H. Gerin, M. (Ecole Normale Superieure) Lucas, R. (IRAM (Grenoble)	Search for C4H absorption in diffuse clouds at 19 GHz. 1.3 cm
GBT02C-034	Camilo, F. (Columbia Astrophysics Lab) Stairs, I. (U. of British Columbia) Lorimer, D. (U. of Manchester) Backer, D. C. (UC, Berkeley) Ransom, S. (McGill U.)	Timing observations of the young pulsar in supernova remnant 3C58. 21, 38 cm
GBT02C-049	Margot, J. (Caltech) Peale, S. (UC, Santa Barbara) Slade, M. (JPL)	The interiors of Mercury and Venus from their spin dynamics. 3.5 cm
GBT02C-054	Braatz, J. Henkel, C. (MPIfR) Wilson, A. (Maryland) Greenhill, L. (CfA) Moran, J. (CfA)	Measuring nuclear disks in NGC 1386 and IC 2560 (H_2O). 1.3 cm
GBT03A-016	Stairs, I. (U. of British Columbia) Manchester, R. N. (ATNF) Lyne, A. (NRAL)	The physics of a massive pulsar System. 21 cm

GBT03A-023	Stairs, I. (U. of British Columbia) Thorsett, S. (UC, Santa Cruz) Arzoumanian, Z. (NASA/GSFC)	Timing binary pulsars at the GBT. 21 cm
GBT03A-027	Ransom, S. (McGill U.) Kaspi, V. (McGill U.)	Confirmation observations of a newly discovered pulsar. 50, 21 cm
GBT03B-009	Stairs, I. (U. of British Columbia) Backer, D. (UC, Berkeley) Rajagopalan, R. (UC, Berkeley)	A drift-scan pulsar survey. 38 cm
GBT03B-037	Ransom, S. (McGill U.) Ray, P. (NRL) Kaspi, V. (McGill U.) Dib, R.	Target-of-Opportunity: XTE J1807-294. 11 cm

VLA Observing Programs

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

No.	Observer(s)	Programs
AA267	Alexander, P. (Cambridge) Riley, J. (Cambridge) Pooley, G. (Cambridge) Fabian, A. (Cambridge) Hardcastle, M. (Bristol, UK) Worrall, D. (Bristol, UK) Cotter, G. (Cambridge) Inskip, K. (Cambridge) Allen, S. (Cambridge) Crawford, C. (Cambridge)	Formation of cold clouds by FRII radio sources. 2 cm
AA281	Axon, D. (Hertfordshire) Gallimore, J.F. (Bucknell) Pedlar, A. (Manchester) Baum, S. (STScI)	Radio relics of Seyfert galaxies. 6 cm
AB1039	Bignall, H. Jauncey, D. (ATNF) Lovell, J. (ATNF) Kedziora-Chudczer, L. (ATNF) Tzioumis, T. (ATNF) Macquart, J-P. (Groningen/Kapteyn)	ISM properties toward the Intraday variable PKS 1257-326. 3.6 cm
AB1057	Bagchi, J. (IUCAA)	Diffuse sources in merging cluster Abell 3376. 20 cm
AB1059	Bastian, T. Gary, D. (NJIT) Lee, J. (Arizona) Benz, A. (SFIT, ETH) Vilmer, N. (Paris Obs) Klein, K. (Paris Obs)	Joint microwave and hard X-ray imaging of impulsive solar flares. 0.7, 1.3, 2, 3.6, 6 cm
AB1066	Beck, R. (MPIR, Bonn) Frick, P. (ICMM, Russia) Patrickeyev, I. (ICMM, Russia)	Magnetic phenomena in the spiral galaxy IH 342. 3.6, 6 cm
AB1069	Beswick, R. (Manchester) Pedlar, A. (Manchester) Muxlow, T. (Manchester) Wills, K. (Sheffield) Gallimore, J. (Bucknell) Strong, M. (Manchester)	HI emission and absorption in starburst galaxies. 20 cm

AB1074	Bolatto, A. (UC, Berkeley) Walter, F. Simon, J. (UC, Berkeley) Mihos, C. (Case Western Reserve) Robishaw, T. (UC, Berkeley)	Extended atomic hydrogen in the Leo triplet. 20 cm
AB1076	Brogan, C. Vastel, C. (Caltech) Wannier, P. (JPL)	HI synthesis observations toward W31C. 20 cm
AB1077	Brogan, C. Kassim, N. (NRL) Lazio, T. J. W. (NRL)	Low frequency observations of the W51 complex. 90 cm
AB1079	Birkinshaw, M. (Bristol, UK)	CXO J0841+1311 Jet. 3.6 cm
AB1080	Bower, G. (UC, Berkeley) Plambeck, R. (UC, Berkeley) Bolatto, A. (UC, Berkeley)	BIMA observations. 0.7, 1.3, 3.6 cm
AC624	Clemens, M. (Cambridge) Alexander, P. (Cambridge) Cotter, G. (Cambridge) Longair, M. (Cambridge) Nikolic, B. (Cambridge)	Comparison of thermal continuum emission with mid-IR PAH features. 2 cm
AC664	Crapsi, A. (Arcetri) Caselli, P. (Arcetri) Tafalla, M. (OAN) Walmsley, M. (Arcetri)	Ammonia thermometry of prestellar core L1544. 1.3 cm
AC665	Chyzy, K.T. (Jagiellonian) Bomans, D. (Bochum) Klein, U. (Bonn Univ.) Urbanik, M. (Jagiellonian)	Magnetic fields in blue compact galaxy IC10. 3.6 cm
AC666	Choi, M. (SA/IAA, Taiwan) Ho, P. (CFA) Takakuwa, S. (CfA)	Density structure of the inner envelope of Class O protostars. 0.7 cm
AC667	Chyzy, K. (Jagiellonian) Vollmer, B. (MPIR, Bonn) Bomans, D. (Ruhr U.) Beck, R. (MPIR, Bonn) Urbanik, M. (Jagiellonian)	NGC 4569 - a galaxy caught in a stripping process? 6, 20 cm

AC668	Contreras, M. (UNAM) Rodriguez, L. (UNAM) Wilking, F.P. (UNAM)	Interacting winds in O-type binary stars. 3.6 cm
AC669	Castelletti, G. (IAFE) Brogan, C. Dubner, G. (IAFE) Kassim, N. (NRL)	VLA Obs. toward the W44. 90, 400 cm
AC671	Carilli, C. Walter, F. Fan, X. (Princeton) Bertoldi, F. (MPIR, Bonn) Cox, P. (IAP, Paris) Beelen, A. (IAP, Paris) Strauss, M. (Princeton) Petric, A. (Columbia)	Holography at the VLA. 0.7 cm
AC672	Claussen, M. Shirley, Y. Wootten, H.	Search for water maser and OH masers toward the Orion millimeter flare source. 1.3, 18 cm
AD438	Dennett-Thorpe, J. (Kapteyn) de Bruyn, A. (Kapteyn)	Determination of structure of micro arcsecond sources. 1.3, 3.6, 6 cm
AD473	Dunn, D. (UC, Berkeley) de Pater, I. (UC, Berkeley) Molnar, L. (Iowa)	Observations of Saturn's rings at large opening angles. 0.7, 1.3 cm
AD474	Disney, M. (Wales) de Blok, W. (ATNF) Minchin, R. (Wales) Boyce, P. (Bristol, UK) Dalcanton, J. (Washington) Ekers, R. (ATNF) Garcia, D. (Wales) Grossi, M. (Wales) Kilborn, V. (Manchester) Knezek, P. (Johns Hopkins) Linder, S. (Wales) Stavely-Smith, L. (ATNF) West, A. (Washington)	HI sources without optical counterparts, from HIPASS. 20 cm

AD475	Disney, M. (Wales) de Blok, W. (ATNF) Minchin, R. (Wales) Boyce, P. (Bristol, UK) Dalcanton, J. (Washington) Eales, S. (Wales) Ekers, R. (ATNF) Garcia, D. (Wales) Grossi, M. (Wales) Kilborn, V. (Manchester) Knezek, P. (Johns Hopkins) Ryder, S. (AAO) Staveley-Smith, L. (ATNF) Vlahakis, C. (Wales) West, A. (Washington)	Hydrogen-giant galaxies found in HIPASS. 20 cm
AD477	Dubner, G. (IAFE) Castelletti, G. (IAFE) Reynoso, E. (IAFE) Goss, W. M.	SNR Puppis A. 20 cm
AE150	Estalella, R. (Barcelona) Palau, A. (Barcelona)	Protostars in IRAS 20028+2903. 0.7, 1.3 cm
AF394	Fuente, A. (Yebes) Testi, L. (Arcetri) Natta, A. (Arcetri) Rodriguez-Franco, A. (OAN)	Continuum emission towards HBe stars. 0.7, 1.3 cm
AG592	van Gorkom, J. (Columbia) Bravo-Alfaro, H. (Guanajuato U.) Dwarakanath, K. (Raman Institute) Guhathakurta, P. (UC, Santa Cruz) Poggianti, B. (Padova) Schiminovich, D. (Caltech) Valluri, M. (Rutgers) Verheijen, M. (Wisconsin) Wilcots, E. (Wisconsin) Zabludoff, A. (Wisconsin)	HI survey of clusters in the local universe. 20 cm
AG626	Gaensler, B. (CfA) Lazio, T. J. W. (NRL) Brogan, C. Kassim, N. (NRL)	Survey of the inner galaxy. 90 cm

AG639	Govoni, F. (Bologna) Markevitch, M. (CfA) Feretti, L. (Bologna) Giovannini, G. (Bologna)	Radio halos in merging and non-merging galaxy clusters. 20 cm
AG644	Glikman, E. (Columbia) Helfand, D. (Columbia)	Do all red quasars have flat radio spectra? 3.6, 20 cm
AH787	Harris, D. (CfA) Kim, D. (CfA) Fomalont, E.	X-ray - radio comparison in Fornax A. 0.7, 2 cm
AH792	Hollis, J. (NASA/GSFC) Pedelty, J. (NASA/GSFC) Snyder, L. (Illinois) Jewell, P. Lovas, F. (Illinois) Palmer, P. (Chicago) Liu, S. (Caltech)	Search for glycine toward Sgr B2(N-LMH). 0.7 cm
AH795	Hunter, D. (Lowell Obs) Tomita, A. (Wakayma) Sunada, K. (Nobeyama) Elmegreen, B. (IBM) Brinks, E. (Guanajuato U.)	Galaxies with CO J=1-0 observations. 20 cm
AH804	Henkel, C. (MPIR, Bonn) Carilli, C. Menten, K (MPIR, Bonn). Wootten, H. A.	Deuterated hydrogen cyanide in the z=0.9 molecular cloud in PKS 1830-211. 0.7 cm
AH805	Herrnstein, R.M. (CfA) Montero-Castano, M. (Madrid) Ho, P. (CfA)	Ammonia (3,3) and (6,6) in molecular cloud G359.1-0.5. 1.3 cm
AH806	Holzapfel, W. (UC, Berkeley) Carlstrom, J. (Chicago) Dawson, K. (UC, Berkeley)	Inverted spectrum point sources in CMB anisotropy fields. 3.6 cm
AH807	Herrnstein, R.M. (CfA) Montero-Castano, M. (Complutense) Ho, P.T.P. (CfA)	Search for high velocity ammonia near Sagittarius A*. 1.3 cm
AH808	Ho, P. (CfA) Herrnstein, R.M. (CfA)	Ammonia (6,6) in nuclei of galaxies. 1.3 cm

AH809	Han, J. (Beijing Obs) You, X. (Beijing Obs) Men, H. (Beijing Obs) Zhao, J-H. (CfA)	Probe cosmological magnetic field by a RM survey at galactic poles. 20 cm
AI104	Ivison, R. (Royal Obs) Greve, T. (Edinburgh) Carilli, C. Papadopoulos, P. (Leiden) Lewis, G. (AAO)	Mapping high-z gas-rich mergers via 12CO J=1-0. 0.7, 1.3 cm
AI105	Isaak, K. (Cambridge) Chandler, C. Carilli, C.	HCN emission from z=4.69 radio quiet quasar BR 1202-0725. 2 cm
AJ293	Johnson, K. Kobulnicky, C. (Wisconsin)	Q-band observations of optically thick free-free sources in He2-10. 0.7 cm
AJ302	Jonker, P. (Cambridge) Fender, R. (Amsterdam) Dubus, G. (IAP) Dhawan, V. Rupen, M.	X-ray transient XTE J1908+094. 3.6 cm
AK504	Kulkarni, S. (Caltech) Diercks, A. (Caltech) Frail, D. Galama, T. (Caltech) Kaplan, D. (Caltech) Rupen, M.	Prompt observations and monitoring of SNe with suspect central engines. 2, 3.5, 6, 20 cm
AK509	Kulkarni, S. (Caltech) Frail, D. Galama, T. (Caltech) Bloom, J. (Caltech) Berger, E. (Caltech) Harrison, F. (Caltech)	Radio afterglows from gamma ray bursts. 0.7, 1.3, 2, 3.5, 6, 20 cm
AK533	Kempner, J. (Virginia) Sarazin, C. (Virginia) Rudnick, L. (Minnesota)	Cluster radio relics discovered in WENSS. 20, 90 cm
AK550	Kulkarni, S. (Caltech) Berger, E. (Caltech) Soderberg, A. (Caltech) Chevalier, R. (Virginia)	Supernovae with suspect central engines. 1.3, 3.5, 6, 20 cm

AK553	Kenney, J. (Yale) van Gorkom, J. (Columbia) Vollmer, B. (MPIR, Bonn)	HI in highly inclined ram pressure stripped spirals in Virgo Cluster. 20 cm
AK554	Koopmans, L. (Caltech) de Bruyn, A. G. (NFRA) Fassnacht, C. (STScI) Wambsganss, J. (API, Potsdam) Blandford, R. (Caltech)	Compact halo objects at z=0.41 via radio microlensing in B1600+434. 2, 3.6, 6 cm
AK557	Kothes, R. (DRAO) Landecker, T. (DRAO)	HI absorption in four supernova remnants for kinematic distances. 20 cm
AK560	Keto, E. (CfA)	Continuing accretion in massive star formation. 0.7, 1.3 cm
AL557	Lovell, J. (ATNF) Bignall, H. (Adelaide) Jauncey, D. (ATNF) Tzioumis, A. (ATNF) Kedziora-Chudczer, L. (ATNF) Reynolds, J. (ATNF) Rickett, B. (UC, San Diego) Marcquart, J. (Groningen/Kapteyn)	Northern hemisphere intra-day variable survey. 3.6, 6 cm
AL584	Lai, S-P. (JPL) Velusamy, T. (JPL) Langer, W. (JPL)	Pre-protostellar core B68. 1.3 cm
AL586	Lockman, F. J. Rupen, M. Liszt, H.	Structure and shape of newly discovered halo HI clouds. 20 cm
AL587	Lang, C. (Iowa) Lazio, T. J. W. (NRL)	Higher frequency mosaic of the Galactic Center. 6 cm
AM702	Markovic, T. (NMIMT) Owen, F. Eilek, J. (NMIMT)	Radio halos in Abell Clusters of galaxies. 20 cm
AM727	Monnier, J. (CfA) Greenhill, L. (CfA) Tuthill, P. (Sydney) Danchi, W. (NASA/GSFC)	Colliding wind binary WR 112. 3.6 cm
AM743	Machalski, J. (Jagiellonian) Jamrozy, M. (Bonn University)	Mapping of radio lobes in giant sources. 6 cm

AM744	Mirabel, I. (CNRS, France) Ribo, M. (Barcelona) Marti, J. (U. Jaen)	Simultaneous observations with the INTEGRAL galactic plane survey. 2, 3.6, 6, 20 cm
AM746	Murgia, M. (Bologna) Parma, P. (Bologna) Fanti, R. (Bologna) de Ruiter, H. (Bologna) Bondi, M. (Bologna) Ekers, R. (ATNF) Fomalont, E.	High-frequency observations of the radio galaxy NGC 326. 2 cm
AM747	Murgia, M. (Bologna) Parma, P. (Bologna) Fanti, R. (Bologna) de Ruiter, H. (Bologna) Fanti, R. (Bologna)	Relic radio galaxies. 3.6, 6 cm
AM749	Moscadelli, L. (Bologna) Furuya, R. (Arcetri) Claussen, M. Kitamura, Y. (ISAS, Japan) Testi, L. (Arcetri) Wootten, A.	Low mass YSOs explored by H_2O masers. 1.3 cm
AM752	Mueller, K. (Univ. of Texas) Evans II, N. (Univ. of Texas) Shirley, Y.	Probing cold, dense gas toward pre-proto stellar cores with formaldehyde. 6 cm
AM753	Minchin, R. (Wales) Disney, M. (Wales) de Blok, W. (ATNF) Grossi, M. (Wales) Garcia, D. (Wales)	Identification of sources found in the HI DEEP survey. 20 cm
AM754	Moffett, D. Reynoso, E. (IAFE) Hughes, J. (Rutgers)	Measuring the expansion of SN 1006. 20 cm
AM756	Mundy, L. (Maryland) Henning, T. (MPIA, Heidelberg) Wilner, D. (CfA) Chandler, C.	Dust properties in T Tauri systems: VLA 7mm observations. 0.7, 1.3 cm
AM758	van Moorsel, G.	HI in NGC2403. 20 cm
AM761	Menten, K. (MPIR, Bonn)	Search for Aminoacetonitrile. 3.6 cm

AO159	Owen, F. O'Dea, C. (STScI) van der Marel, R. (STScI) Laine, S. (STScI) Postman, M. (STScI) Lauer, T. (KPNO-NOAO)	Radio sources and black holes in brightest cluster galaxies. 20 cm
AO163	Owen, F. Lonsdale, C. (Caltech) Morrison, G. (IPAC) Smith, G. (UC, Berkeley) Xu, C. (IPAC)	Very deep radio/SIRTF survey: faint source, radio FIR correlation. 20 cm
AP450	Partridge, B. (Haverford College) Guerra, E. (Rowan) Cabanela, J. (Haverford College) Myers, S.	Spectra of inverted spectrum radio sources from 4.8 GHz to 43 GHz. 0.7, 1.3, 3.6, 6 cm
AQ015	Qi, C. (CfA) Zhang, Q. (CfA) Wilner, D. (CfA) Blake, G. (Caltech)	Dust grain growth in protoplanetary disks. 0.7, 3.6 cm
AR476	Rupen, M. Mioduszewski, A. Dhawan, V.	Galactic X-ray binaries and transients. 0.7, 1.3, 2, 3.6, 20, 90 cm
AR477	Rawlings, S. (Oxford) Dunlop, J. (ROE) Hill, G. (McDonald Observatory) Jarvis, M. (Leiden) McLure, R. (Oxford) Mitchell, E. (Oxford) Willott, C. (Oxford)	What controls the spread in radio luminosity of massive elliptical galaxies? 3.5, 6, 20 cm
AR508	Rupen, M. Mioduszewski, A. Dhawan, V. Ribo, M. (Barcelona)	Galactic x-ray binaries. 0.7, 1.3, 2, 3.6, 6, 20, 90 cm
AR509	Rodriguez-Rico, C. (Mexico/UNAM) Goss, W.M. Zhao, J-H. (CfA) Viallefond, F. (Paris Obs)	Hydrogen recombination line H53 at 7mm from starburst galaxy NGC253. 0.7 cm
AR512	Rector, T.	Two radio quiet BL Lacs? 6 cm

AS711	Saito, M. (CfA) Kawabe, R. (NAO, Japan) Beltran, M. (CfA)	Continuum observations of low-mass protostars in Taurus. 3.6 cm
AS735	Sridharan, T. (CfA) Zhang, Q. (CfA) Wyrowski, F. (MPIR, Bonn) Hunter, T. (CfA) Beuther, H. (MPIR, Bonn) Schilke, P. (MPIR, Bonn)	Resolving disks around two high-mass (proto) stars. 1.3 cm
AS742	Sjouwerman, L. Pihlstrom, Y. Dwarakanath, K.	Ammonia in—0.13-0.08. 1.3 cm
AS745	Solomon, P. (SUNY) Vanden Bout, P. Carilli, C.	Dense molecular gas and star formation in high redshift galaxies. 1.3 cm
AS746	Severgini, P. (INAF-OAB) Caccianiga, A. (INAF-OAB) Della Ceca, R. (INAF-OAB) Maccaro, T. (INAF-OAB) Wolter, A. (INAF-OAB) Barcons, X. (IFCA)	XMMU J0338-3526, an apparently passive galaxy with X-ray emission. 6, 20 cm
AS747	Sridharan, T. (CfA) Zhang, Q. (CfA) Wyrowski, F. (MPIR, Bonn) Hunter, T. (CfA) Beuther, H. (MPIR, Bonn) Schilke, P. (MPIR, Bonn)	Ammonia disks around high mass young stars. 1.3 cm
AS748	Spoon, H. (Groningen/Kapteyn) van der Hulst, T. (Groningen/Kapteyn) Evans, A. (Keele) Klockner, H-R. (Groningen/Kapteyn) Boomsma, R. (Kapteyn)	Search for an HI bridge between NGC 4418 & VV 655. 20 cm
AS749	Sollins, P. (CfA) Ho, P. (CfA) Zhang, Q. (CfA)	Searching for infall in hot molecular cores. 1.3 cm

AS750	Schinnerer, E. Mundell, C. (Liverpool JMU) Garcia-Burillo, S. (Liverpool JMU) Combes, F. (Paris Obs) Ulvestad, J.	HI in a CO selected galaxy sample. 20 cm
AS751	Shirley, Y. Wootten, H. A.	Ammonia thermometry of low mass star forming cores. 1.3 cm
AS752	Schinnerer, E. O'Neil, K. (Arecibo)	HI in massive low surface brightness galaxies. 20 cm
AS753	Sewilo, M. (Wisconsin) Churchwell, E. (Wisconsin) Goss, W. M. Kurtz, S. (Mexico/UNAM) Hofner, P. (Puerto Rico)	Broad radio recombination lines in ultra compact HII regions. 0.7 cm
AS755	Stanimirovic, S. (NAIC) Salter, C. (NAIC) Urosevic, D. (Belgrade)	Possible interaction between SNR G42.8+0.6 and a molecular cloud. 20 cm
AS757	Sridharan, T.K. (CfA) Zhang, Q. (CfA) Hunter, T. (CfA) Wyrowski, F. (MPIR, Bonn) Beuther, H. (MPIR, Bonn) Schilke, P. (MPIR, Bonn)	Dust disks around high mass protostars. 0.7, 3.6 cm
AS758	Shepherd, D. Claussen, M. Kurtz, S. (Mexico/UNAM)	Tracing a circumbinary disk around massive protostar G192.16-3.82. 1.3 cm
AT282	Testi, L. (Arcetri) Natta, A. (Arcetri) Wilner, D. (CfA) Shepherd, D.	Herbig Ae stars. 0.7, 3.6 cm
AT285	Thornley, M. (Bucknell) Kennicutt, R. (Arizona) Kewley, L. (CfA) Regan, M. (DTM/Carnegie) Walter, F.	HI in galaxies in the SIRTIF Nearby Galaxies Survey. 20 cm

AT286	Thornley, M. (Bucknell) Kennicutt, R. (Arizona) Kewley, L. (CfA) Helou, G. (IPAC)	Radio-FIR relation on kpc scales in SIRTIF Nearby Galaxy Survey. 20 cm
AT287	Trung, D. (SA/IAA, Taiwan) Lim, J. (SA/IAA, Taiwan)	Equatorial disk and central torus of the Egg nebula. 0.7, 1.3 cm
AT289	Tinti, S. (Brera Obs) Caccianiga, A. (Brera Obs) Wolter, A. (Brera Obs) Celotti, A. (Brera Obs)	Flat spectrum radio quasars from the REX survey. 6, 20 cm
AU093	Umana, G. (Bologna) Trigilio, C. (Bologna) Cerrigone, L. (Catania)	Radio characteristics of young planetary nebulae. 1.3, 2, 6, 20 cm
AW576	Winn, J. (CfA) Biggs, A. (Manchester) Fassnacht, C. (STScI) Koopmans, L. (Caltech) Lovell, J. (ATNF) Rusin, D. (CfA)	Time delays in gravitational lenses. 3.6 cm
AW579	Weiler, K. (NRL) Panagia, N. (STScI) Sramek, R. Stockdale, C. (NRL) Van Dyk, S. (IPAC)	Properties of radio supernovae. 1.3, 2, 3.5, 6, 20, 90 cm
AW593	Weiler, K. (NRL) Stockdale, C. (NRL) Sramek, R. Van Dyk, S. (IPAC) Panagia, N. (STScI) Marcaide, J. (Valencia) Lewin, W. (MIT) Pooley, D. (MIT) Immler, S. (Massachusetts)	ToO observations of supernovae. 1.3, 2, 3.6, 6, 20, 90 cm
AW596	Willson, R. (Tufts)	VLA-RHESSI investigations of solar flares and microflares. 1.3, 2, 3.6 cm
AW597	Wilson, T. (MPIR, Bonn) Martin-Pintado, J. (Yebes Obs) Chandler, C.	Thermal SiO emission from the HII region/molecular cloud interface. 0.7 cm

AW598	Wilson, T. (MPIR, Bonn) Gaume, R. (USNO) Boboltz, D. (USNO) Megeath, S. (CfA)	Imaging ground state SiO emission in W3 high mass starforming region. 0.7 cm
AW601	Wilcots, E. (Wisconsin) Pisano, D. (ATNF) Freeland, E.	The dynamical evolution of galaxy groups. 20 cm
AW604	Walter, F. Skillman, E. (Minnesota)	Systematic search for HI in lowest-mass dwarf spheroidal galaxies. 20 cm
AY133	Young, L. (NMIMT) Skillman, E. (Minnesota)	Phoenix: a dwarf spheroidal galaxy with an adjacent HI cloud. 20 cm
AY136	Yusef-Zadeh, F. (Northwestern) Law, C. (Northwestern) Cotton, W.	327 MHz mapping near l,b=-1°,-0.5° at 327 MHz . 90 cm
AY137	Yusef-Zadeh, F. (Northwestern) Cotton, W.D. Law, C. (Northwestern)	GBT+VLA mosaic image of the Galactic center region. 20 cm
AY138	Yusef-Zadeh, F. (Northwestern) Roberts, D. (Brandeis) Wardle, M. (MacQuarie)	Search for OH toward supernova remnants. 20 cm
AZ136	Zhao, J- H. (CfA) Herrnstein, R.M. (CfA) Goss, W. M. Bower, G. (UC, Berkeley)	VLA monitoring the 106-day cycle of Sgr A. 0.7, 1.3, 2 cm
AZ141	Zhang, X.Z. (NAO, China) Jin, C.J. (NAO, China) Reich, W. (MPIR, Bonn) Tian, W.W. (Beijing) Wu, J.H. (NAO, China)	Observations of four new supernova remnant candidates. 6 cm
AZ143	Zhao, J-H. (CfA) Herrnstein, R.M. (CfA) Cotton, W. Bower, G. (UC, Berkeley) Pegg, J. (CfA)	Monitoring quasi-periodic oscillations of Sgr A*. 0.7, 1.3, 2 cm
GB045	Bartel, N. (York U.) Bietenholz, M. (York U.) Rupen, M.	SN 1986J - evolution of its shell and search for a pulsar nebula. 2, 6, 20 cm

VLBA Observing Programs

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

No.	Observer(s)	Programs
AB080	Bower, G. (UC, Berkeley)	BIMA observations at 86 GHz. 1,2 cm
BA045	Alberdi, A. (IAA, Spain) Gomez, J. F. (IAA, Spain) Marcaide, J. (Valencia) Marscher, A. (Boston) Perez-Torres, M. (IRA)	Interaction of moving and standing components in 4C39.25. 1, 2, 7 cm
BA053	Attridge, J. (Haystack) Homan, D. Phillips, R. (Haystack) Wardle, J. (Brandeis)	Linear polarization of five AGN with the VLBA. 3,7 cm
BA064	Asada, K. (NAO) Inoue, M. (NAO) Kameno, S. (NAO) Nagai, H. (NAO) Uchida, Y. (Science Univ.)	Faraday rotation measure survey of AGN jets. 2,4,6,13 cm
BA067	Anderson, J. (NMIMT) Ulvestad, J.	Measuring LLAGN sizes using intraday variability studies. 4 cm
BB138	Bach, U. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn)	Motion in the counter jet of Cygnus A. 2, 6 cm
BB152	Bach, U. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Greve, A. (IRAM) Krichbaum, T. (MPIR, Bonn) Terasranta, H. (Metsahovi) Witzel, A. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn)	Precessing or helical jet in NRAO 150? 1.3, 4, 0.7 cm
BB153	Bach, U. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Middelberg, E. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn)	Measuring the core shift in Cygnus A. 1.3, 2 cm

BB158	Beuther, H. (MPIR, Bonn) Moscadelli, L. (Cagliari) Schilke, P. (MPIR, Bonn)	H_20 and CH_3 OH maser emission toward the massive protostellar object IRAS 19217+1651. 1 cm
BB160	Boboltz, D. (USNO) Fey, A. (USNO) Johnston, K. (USNO)	VLBA Study of the RS CVn binary system. 4 cm
BB165	Boehmer, K. (Fox Lane HS) Marscher, A. (Boston University)	Consequences of changing jet direction in quasar CTA 102. 1, 0.7 cm
BC118	Cawthorne, T. (Lancashire) Papageorgiou, A. (Lancashire) Stirling, A. (Lancashire) Gabuzda, D. (Cork)	Polarization monitoring of the radio jet in 4C71.07. 2,4,6,0.7 cm
BC119	Cheung, C. (Brandeis) Homan, D. (Brandeis) Roberts, D. (Brandeis) Sambruna, R. (George Mason) Urry, C. (STScI) Wardle, J. (Brandeis)	Full stokes imaging of a sample of detected and non-detected X-ray jets. 2, 4 cm
BC120	Chatterjee, S. (Cornell) Backer, D. (UC, Berkeley) Benson, J. Brisken, W. Cordes, J. (Cornell) Ellis, R. (UC, Santa Cruz) Fomalont, E. Golden, A. (Univ. of Ireland) Goss, W.M. Kramer, M. (Manchester) Lazio, T. J.W. (NRL) Lyne, A. (Manchester) McKinnon, M. Thorsett, S. (UC, Santa Cruz) Wong, D. (Cornell)	Pulsar astrometry with the VLBA. 20 cm

BC123	Chatterjee, S. (Cornell) Backer, D. (UC, Berkeley) Benson, J. Brisken, W. Cordes, J. (Cornell) Ellis, R. (UC, Santa Cruz) Fomalont, E. Golden, A. (Univ. of Ireland) Goss, W.M. Kramer, M. (Manchester) Lazio, T.J.W (NRL) Lyne, A. (Manchester) McKinnon, M. Thorsett, S. (UC, Santa Cruz) Wong, D. (Cornell)	First epoch pulsar astrometry with the VLBA. 20 cm
BC134	Chatterjee, S. (Cornell) Cordes, J. (Cornell) McLaughlin, M. (Manchester) Lazio, T. J. W. (NRL) Arzoumanian, Z. (NASA/GSFC)	Proper motion of a faint anomalously-located pulsar. 18 cm
BD078	Dhawan, V. Kellermann, K. Romney, J.	Monitoring the accelerating, bent jet in 3C84. 7 cm
BD084	Doi, A. (Univ. Tokyo) Kameno, S. (NAO) Kohno, K. (Univ. Tokyo)	Free-free absorption by narrow line regions in Seyfert 1 galaxy. 20 cm
BD086	Doi, A. (Univ. Tokyo) Kameno, S. (NAO) Kohno, K. (Univ. Tokyo)	VLBI imaging of high frequency excess objects. 0.4,6,13,20 cm
BE025	Engels, D. (Hamburger Sternwarte) Brand, J. (Inst. di Radioastronomia) Perez-Torres, M-A. (Inst. di Radioastronomia)	Imaging the putative disk of the transvestite star V778 Cyg. 1 cm
BE029	Edwards, P. (ISAS) Falcone, A. (Purdue Horan, D. (CfA) Kataoka, J. (Tokyo Inst.) Piner, B. (Whittier College)	Structure and evolution of the TeV gamma ray source H1426+428. 4 cm

BG114	Gabuzda, D. (Cork) Cawthorne, T.V. (Lancashire) Pushkarev, A.B. (ASC)	Toroidal B fields in BL Lac objects. 0.7,1,2,4, 6 cm
BG128	Gabuzda, D. (Cork) Rastorgueva, E. (Moscow/SSAI) Smith, P. (Arizona)	Simultaneous optical and VLBI polarization observations. 0.7, 1.3, 2 cm
BG129	Greenhill, L. (CfA) Chandler, C. Reid, M. (CfA) Moran, J. (CfA) Diamond, P. (Manchester)	SiO proper motions in Orion KL. 0.7 cm
BG132	Greenhill, L. (CfA) Kondratko, P. (CfA) Moran, J. (CfA) Lovell, J. (ATNF) Jauncey, D. (ATNF) Kuiper, T. (JPL)	Follow-up imaging of Southern H_2O masers detected with the DSN. 1.3 cm
BG134	Greenhill, L. (CfA) Kondratko, P. (CfA) Lovell, J. (ATNF) Kuiper, T. (JPL) Moran, J. (CfA) Jauncey, D. (ATNF)	Follow-up imaging of water megamasers detected with the DSN. 1.3 cm
BH097	Hoffman, I. Goss, W. M. Brogan, C. Claussen, M.	Full stokes observations of the 1720 MHz OH masers in W28. 18 cm
BH102	Hoffman, I. Brogan, C. Claussen, M.	Full stokes observations of the W44 OH(1720 MHz) masers. 18 cm
BH103	Homan, D. Kovalev, Y. (ASC)	Measuring frequency dependent core positions in VLBI jets. 2, 4, 6, 13 cm
BH104	Homan, D.	The 180d misaligned jet in PKS 1510-089. 18 cm
BH105	Hough, D. (Trinity) Aars, C. (Texas Christian Univ.)	Variability in the nuclei of lobe-dominated quasars, Part II. 2, 4 cm

BH107	Horiuchi, S. (JPL) Migenes, V. (Guanjuato) Kameya, O. (NAO)	Highly polarized water masers in Orion KL. 1 cm
BH110	Hines, D. (Univ. of Arizona) Wrobel, J.	Imaging the hidden QSO IRAS P090104+4109. 20 cm
BI025	Imai, H. (NAO)	Exploration of collimated molecular jets in OH/IR stars. 1 cm
BJ036	Jorstad, S. (Boston) Marscher, A. (Boston) Yurchenko, A. (St. Petersburg Univ.)	BL Lac objects with high proper motion. 1.3, 2, 4, 0.7 cm
BJ044	Jauncey, D. (ATNF) Bignall, H. (ATNF) Fey, A. (USNO) Johnston, K. (USNO) Kedziora-Chudczer, L. (ATNF) Lovell, J. (ATNF) Macquart, J. (Kapteyn) Ojha, R. (ATNF) Reynolds, J. (ATNF) Tzioumis, T. (ATNF)	Snapshot imaging of scintillating sources. 4 cm
BK092	Krichbaum, T. (MPIR, Bonn) Aller, H. (Michigan) Aller, M. (Michigan) Bach, U. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Polatidis, A. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn) Ungerechts, H. (Massachusetts) Terasranta, H. (Helsinki)	VLBA monitoring of 1633+382 during a major millimeter flare. 1.3, 3, 0.7 cm
BK099	Kulkarni, S. (Caltech) Berger, E. (Caltech) Frail, D. Soderberg, A. (Caltech)	Observations of type Ic SN 2003L. 6 cm
BL104	Lobanov, A. (MPIR, Bonn) Roland, J. (IAP) Ros, E. (MPIR, Bonn) Zensus, J. A. (MPIR, Bonn)	Cross-band monitoring of a flare in the VLBI core of 3C345. 0.7, 1.3, 2 cm

BL105	Lobanov, A. (MPIR, Bonn) Klare, J. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Zensus, J. A. MPIR, Bonn)	Multi-frequency monitoring of the parsec-scale jet in 3C345. 2, 4, 6 cm
BL111	Lister, M. Aller, H. (Michigan) Aller, M. (Michigan) Cohen, M. (Caltech) Homan, D. Kadler, M. (MPIR, Bonn) Kellermann, K. Kovalev, Y. (Lebedev) Lobanov, A. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Vermeulen, R. (NFRA) Zensus, J. A. (MPIR, Bonn)	MOJAVE Program: monitoring of jets in AGN with VLBA experiments. 2 cm
BL113	Lazio, T.J.W (NRL) Chatterjee, S. (Cornell) Cordes, J. (Cornell) Kramer, M. (Manchester)	B1849+005 and PSR B1849+00: a scattering comparison. 18 cm
BL114	Lazio, T. (NRL) Cordes, J. (Cornell) Gotthelf, E. (Columbia) Lang, C. (Iowa) Wang, D. (UMASS)	Radio counterpart to a Chandra X-ray source toward the galactic center. 4, 6, 13 cm
BM165	Minier, V. (Wales) Balaubramanyam, R. (Wales) Burton, M. (Wales) Walsh, A. (CfA)	Search for protostellar disks in hot cores. 2 cm
BM171	Marscher, A. (Boston University) Aller, M. (Michigan) Gomez, J. (IAA, Spain) Jorstad, S. (Boston University) Marscher, A. (Boston University) McHardy, I. (Southampton)	Relationship between X-ray events and superluminal ejections in blazars. 1.3, 0.7 cm
BM176	Momjian, E. Romney, J. Carilli, C. Troland, T. (Kentucky)	VLBA continuum and HI absorption observations of LIG UGC 2369. 18 cm

BM177	Miyoshi, M. (NAO) Deguchi, S. (NAO) Imai, H. (JIVE) Nakashima, J. (NAO)	Precise proper motion measurement of the SiO maser sources at the Galactic Center relative to Sgr A* (II). 7 cm
BM180	Marvel, K. (AAS) Mannings, V. (IPAC)	Water maser kinematics near Herbig Ae/Be stars. 1 cm
BM182	Ma, C. (NASA/GSFC) Johnston, K. (USNO) Fey, A. (USNO) Boboltz, D. (USNO) Gordon, D. (NASA/GSFC) Gaume, R. (USNO) Kingham, K. (USNO) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) MacMillan, D. (Interferometrics) Petrov, L. (NASA/GSFC) Fomalont, E. Walker, R. C.	VLBA geodesy/astrometry observations for 2003. 3.6 cm
BM183	Mantovani, F. (Bologna) Saikia, D. (NCRA)	B1524-136: A quasar with two sided jets. 6 cm
BN020	Nakai, N. (NAO, Japan) Yamauchi, A.(NAO) Sato, N. (NAO, Japan) Diamond, P. (Manchester)	Water vapor megamaser in the LINER IC 1481. 1.3 cm
BN021	Nagar, N. (Arcetri) Falcke, H. (MPIR, Bonn) Maoz, D. (Tel Aviv) Wilson, A. (Maryland)	Accretion in low-luminosity AGN: a radio, UV and X-ray variability study. 6 cm
BN022	Nagar, N. (Arcetri) Falcke, H. (MPIR, Bonn) Wilson, A. (Maryland) Maoz, D. (Tel Aviv)	AGN evolution in ultra luminous infrared galaxies. 6 cm
BO013	Ojha, R. (ATNF) Cordes, J. (Cornell) Fey, A. (USNO) Jauncey, D. (ATNF) Kedziora-Chudczer, (ATNF) Lazio, T. J. W. (NRL) Lovell, J. (ATNF)	Intra day variable sources as a probe of the intergalactic medium. 4, 13,20, 90 cm

BO015	O'Dea, C. (STScI) Baum, S. (STScI) Condon, J. Kleijn, G. (ESO) Stanghellini, C. (CNR) Tilak, A. (Johns Hopkins) Wrobel, J.	Jet evolution in FRI radio galaxies. 6, 20 cm
BP016	Petric, A. (Columbia) Carilli, C.	Study of the highest redshift compact steep spectrum sources, and a search for sub-arcsecond scale gravitational lensing. 20 cm
BP088	Peck, A. (CfA) Falcke, H. (MPIR, Bonn) Gallimore, J. (Bucknell) Henkel, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Ulvestad, J.	Tracking the H_20 megamaser in jet of Mrk 348. 1 cm
BR081	Rector, T. Fassnacht, C. (STScI) Myers, S. Taylor, G. Wrobel, J.	AGN content of the Cetus field of the NOAO deep wide-field survey. 6 cm
BR086	Ribo, M. (Univ. De Barcelona) Dhawan, V. Marti, J. F. (Jaen) Mirabel, I. (CEA)	Observations of Galactic gamma-ray sources with INTEGRAL. 2, 4, 13 cm
BR088	Ratner, M. (CfA) Bartel, N. (York U.) Bietenholz, M. (York U.) Lebach, D. (CfA) Lestrade, J-F. (Paris Obs) Ransom, R. (York U.) Shapiro, I. (CfA)	Astrometry of HR 8703 in 2003 for Gravity Probe-B mission. 3.6 cm
BS120	Spangler, S. (Iowa) Cordes, J. (Cornell) Mutel, R. (Iowa)	Investigation of shock associated turbulence in two supernova remnants. 6, 13, 20 cm
BS121	Savolainen, T. (Tuorla Obs.) Courvoisier, T. (INTEGRAL SDC) Valtaoja, E. (Tuorla Obs.) Wiik, K. (Tuorla Obs.)	Physics of AGN, a deep understanding of the quasar 3C273. 0.3, 0.7, 1, 2, 4, 6 cm

BS125	Snellen, I. (IfA) Dunlop, J. (IfA) Floyd, D. (IfA) Kukula, M. (IfA) McLure, R. (McLure)	Relationship between radio core properties and black hole mass in radio loud quasars. 6, 20 cm
BT066	Taylor, G. Pollack, L. (UC, Berkeley)	Follow-up observations of the compact symmetric object 0402+379. 2, 6, 20 cm
BT067	Teng, S. (Maryland) Johnson, K. (Wisconsin) Neff, S. (GSFC) Ulvestad, J.	Super star cluster complex or background AGN? 4 cm
GC023	Charlot, P. (Bordeaux) Lestrade, J-F. (Obs. de Paris) Pradel, N. (Bordeaux)	Phase reference astrometry of compact symmetric objects. 4 cm
GJ010	Jackson, N. (Manchester) Biggs, A. (JIVE) Browne, I. (Manchester) de Bruyn, A.G. (NFRA) Koopmans, L. (Caltech) Mao, S. (Manchester) Wilkinson, P. (Manchester) York, T. (Manchester)	Substructure in CLASS lensing galaxies. 6 cm
GP034	Peck, A. (CfA) Henkel, C. (MPIR, Bonn) Tarchi, A. (Bologna) Nagar, N. (Arcetri)	Megamasers in Mrk 1066 and Mrk 34. 1.3 cm

New Hires

Delgado, Juan	Procurement and Contracts Manager	01/06/03
Fakes, Troy*	Junior Engineering Associate	01/06/03
Kovalev, Yuriy	Research Associate	02/03/03
Marganian, Paul	Software Engineer III	01/20/03
O'Neil, Karen	Assistant Scientist	01/20/03
Rankin, Scott	Software Engineer II	02/18/03
Ravichandran, Satish	Junior Engineering Associate	01/06/03
Roberts, Sarah	Software Engineer III	02/03/03
Satin, Miriam	Administrative Assistant	02/03/03
Scott, Richard	Electronics Engineer II	01/07/03
Tapia, Reydelle	Junior Engineering Associate	01/15/03

Terminations

Heald, Ronald	Software Engineer I	01/31/03
Marquez, Ivan	Junior Engineering Associate	01/17/03
Patscheck, Christopher	Junior Engineering Associate	01/17/03
Spuhler, Philipp	Junior Engineering Associate	01/21/03
Terezon Segura, Brisa	Junior Research Associate	02/07/03

Promotions

Miller, Theodore	Head of Administration	01/01/03
Sowinski, Kenneth	Senior Software Engineer	01/01/03
Treacy, Robert	Electronics Engineer II	01/01/03

Other Changes

Gordon, Mark	Emeritus Scientist	01/01/03

*Rehire

Publications

Attached is a listing of all preprints received in the NRAO Charlottesville library during the reporting period authored by NRAO staff or based on observations on NRAO telescopes.

PREPRINTS RECEIVED, JANUARY - MARCH 2003

BAGCHI, J. Discovery of Giant 'Radio Arcs' in Cluster Abell 3376: Evidence for Shock Accleration in a Violent Cluster Merger?

BERGER, E.; COWIE, L.L.; KULKARNI, S.R.; FRAIL, D.A.; AUSSEL, H.; BARGER, A.J. A Submillimeter and Radio Survey of Gamma-Ray Host Galaxies: A Glimpse into the Future of Star Formation.

CARILLI, C.L.; IVISON, R.J.; FRAIL, D.A. Variability of Sub-mJy Radio Sources.

CESARONI, R.; CODELLA, C.; FURUYA, R.S.; TESTI, L. Anatomy of a High-Mass Star Forming Cloud: the G24.78+0.08 (Proto)Stellar Cluster.

CHEUNG, C.C.; WARDLE, J.F.C.; CHEN, T.; HARITON, S.P. New Detections of Optical Emission from Kiloparsec-Scale Quasar Jets.

COHEN, A.S.; ROTTGERING, H.J.A.; KASSIM, N.E.; COTTON, W.D.; PERLEY, R.A.; WILMAN, R.; BEST, P.; PIERRE, M.; REFREGIER, A.; BIRKINSHAW, M.; BREMER, H.; LIANG, H.; ZANICHELLI, A. Preliminary Results from the Low Frequency Radio Counterpart of the XMM Large Scale Structure Survey.

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COTTON, W.D.; MENNESSON, B.; DIAMOND, P.J.; PERRIN, G.; COUDE DU FORESTO, V.; CHAGNON, G.; VAN LANGEVELDE, H.J.; RIDGWAY, S.; WATERS, R.; VLEMMINGS, W.; MOREL, S.; TRAUB, W.; CARLETON, N.; LACASSE, M. VLBA Observations of SiO Masers Towards Mira Variables.

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DUNLOP, J.S.; MCLURE, R.J.; KUKULA, M.J.; BAUM, S.A.; O'DEA, C.P.; HUGHES, D.H. Quasars, Their Host Galaxies, and Their Central Black Holes.

FISH, V.L.; REID, M.J.; WILNER, D.J.; CHURCHWELL, E. H I Absorption Toward Ultracompact H II Regions: Distances and Galactic Structure.

FOMALONT, E.B.; KOPEIKIN, S.M. The Measurement of the Light Deflection from Jupiter: Experimental Results.

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FRAIL, D.A.; YOST, S.A.; BERGER, E.; HARRISON, F.A.; SARI, R.; KULKARNI, S.R.; TAYLOR, G.B.; BLOOM, J.S.; FOX, D.W.; MORIARTY-SCHIEVEN, G.H.; PRICE, P.A. The Broadband Afterglow of GRB 980703.

GALAMA, T.J.; REICHART, D.; BROWN, T.M.; KIMBLE, R.A.; PRICE, P.A.; BERGER, E.; FRAIL, D.A.; KULKARNI, S.R.; YOST, S.A.; GAL-YAM, A.; BLOOM, J.S.; HARRISON, F.A.; SARI, R.; FOX, D.; DJORGOVSKI, S.G. Hubble Space Telescope and Ground-Based Optical and Ultraviolet Observations of GRB 010222.

GLENN, J.; JEWELL, P.R.; FOURRE, R.; MIAJA, L. A Polarization Survey of SiO Maser Variability in Evolved Stars.

GOSS, W.M. Sagittarius A* as an AGN.

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HIGDON, J.L.; WALLIN, J.F. A Minor-Merger Interpretation for NGC 1097's 'Jets'

HO, L.C.; TERASHIMA, Y.; ULVESTAD, J.S. Detection of the "Active" Nucleus of M32.

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KAPLAN, D.L.; VAN KERKWIJK, M.H.; MARSHALL, H.L.; JACOBY, B.A.; KULKARNI, S.R.; FRAIL, D.A. The Nearby Neutron Star RX J0720.4-3125 from Radio to X-rays.

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MILLER, N.A.; OWEN, F.N. Abell 2255: Increased Star Formation and AGN Activity in a Cluster-Cluster Merger.

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PECK, A.B.; HENKEL, C.; ULVESTAD, J.S.; BRUNTHALER, A.; FALCKE, H.; ELITZUR, M.; MENTEN, K.M.; GALLIMORE, J.F. The Flaring H2O Megamaser and Compact Radio Source in Mrk 348.

PINER, B.G.; UNWIN, S.C.; WEHRLE, A.E.; ZOOK, A.C.; URRY, C.M.; GILMORE, D.M. The Speed and Orientation of the Parsec-Scale Jet in 3C 279.

POLLACK, L.K.; TAYLOR, G.B.; ZAVALA, R.T. Poilarimetry of 177 Sources from the Caltech-Jodrell Flat-Spectrum Survey.

ROSHI, D.A. RFI Mitigation/Excision Techniques.

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SCHOLLER, M.; GITTON, P.; ARGOMEDO, J.; BALLESTER, P.; BAUVIR, B.; VAN BOEKEL, R.; CANTZLER, M.; CORREIA, S.; COTTON, W.; DELPLANCKE, F.; DERIE, F.; DUHOUX, P.; ERM, T.; DI FOLCO, E.; COUDE DU FORESTO, V.; GENNAI, A.; GILLI, B.; GIORDANO, P.; GLINDEMANN, A.; GUISARD, S.; GUTIERREZ, P.; HOUSEN, N.; HUDEPOHL, G.; HUXLEY, A.; JACKISCH, S.; JAFFE, W.; KERVELLA, P.; VAN KESTEREN, A.; KIEKEBUSCH, M.; KOEHLER, B.; LEVEQUE, S.; LONGINOTTI, A.; MENARDI, S.; MOREL, S.; NOETHE, L.; PARESCE, F.; PERCHERON, I.; PHAN DUC, T.; PINO, A.; RABELING, D.; RAMIREZ, A.; ROBBE, S.; RICHICHI, A.; RIJO, A.; SABET, C.; SANDROCK, S.; SEGRANSAN, D.; SPYROMILIO, J.; TAMAI, R.; TARENGHI, M.; WALLANDER, A.; WILHELM, R.; WITTKOWSKI, M. Commissioning the VLT Interferometer: From First Fringes Towards a General User Facility.

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TRINIDAD, M.A.; CURIEL, S.; CANTO, J.; D'ALESSIO, P.; RODRIGUEZ, L.F.; TORRELLES, J.M.; GOMEZ, J.F.; PATEL, N.; HO, P.T.P. Observations of Water Masers and Radio Continuum Emission in AFGL 2591.

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