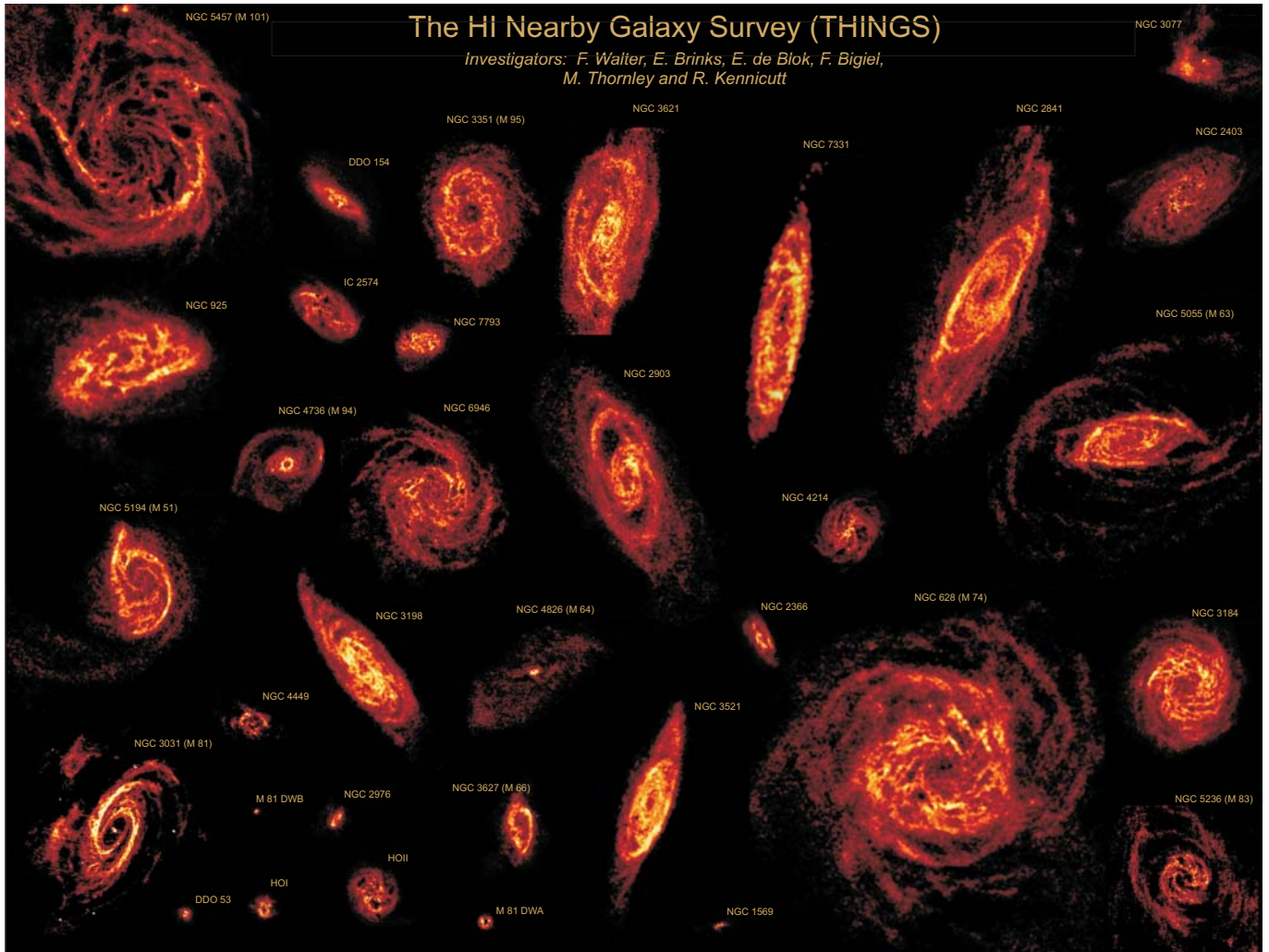


NATIONAL RADIO ASTRONOMY OBSERVATORY



Quarterly Report



January – March 2008

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Cover Image: The HI Nearby Galaxy Survey (THINGS) teams presented the first results of their 500-hour VLA observing project that produced high-resolution images of 34 nearby galaxies. THINGS has yielded new insights on the gas-density threshold required to trigger star formation, new details of complex structures in the ISM, the sizes of gas disks in spiral galaxies, and measurements of non-circular motions in galaxies that are too small to explain the failure of computer simulations to describe the distribution of dark matter in disk galaxies.

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EXECUTIVE SUMMARY

The HI Nearby Galaxy Survey (THINGS) teams presented the first results of their 500-hour VLA observing project that produced high-resolution images of 34 nearby galaxies. THINGS has yielded new insights on the gas-density threshold required to trigger star formation, new details of complex structures in the ISM, the sizes of gas disks in spiral galaxies, and measurements of non-circular motions in galaxies that are too small to explain the failure of computer simulations to describe the distribution of dark matter in disk galaxies. GBT observers measured several transitions of formaldehyde in a set of infrared-bright starburst galaxies and derived accurate measurements of the density of molecular hydrogen. Bistatic Arecibo/GBT radar images of the Aristarchus lunar plateau in both circular polarizations opened a new window on the geologic history, resources, and potential hazards of this region.

Fifteen EVLA antennas have been retrofitted and restored to routine service; the sixteenth has nearly completed its mechanical overhaul. Renovation of the Visitor Center Theater at the VLA site was completed about two weeks ahead of schedule.

The fourth NA ALMA antenna arrived at the OSF. The NAASC recruited staff to prepare for early operations and hired an ALMA EPO Program Officer and an Assistant Scientist for Commissioning. NAASC staff supported the beta release of the CASA offline software and tested beta patch 1. The third NAASC science workshop is being organized for the fall.

New Mexico Operations responded to a proposal made to the State of New Mexico for constructing a high-voltage power line across the east and west arms of the VLA. With the assistance of AUI and senior NRAO management, we are enlisting the assistance of New Mexico's Federal, state, and local legislative representatives to find an alternative to the proposed power-line route.

New 22 GHz receiving systems, funded by the Max Planck Institut für Radioastronomie, were installed on all VLBA antennas and demonstrated the expected 30% noise reduction. The replacement maser for the VLBA was installed. Test observations of NASA's Phoenix Lander and three other spacecraft orbiting Mars were successfully carried out during March. The VLBA will track the Phoenix spacecraft's descent near Mars' North Pole on May 25 as part of a New Initiatives Office demonstration project for NASA. A Mission of Opportunity proposal was submitted to NASA for support of a U.S. key science team that would use the VLBA and VSOP-2 after VSOP-2 launch in 2012.

Three new instruments were successfully commissioned on the GBT: the MUSTANG 90 GHz bolometer array, the Zpectrometer wideband backend, and the Ka-band 26–40 GHz cross-correlation receiver.

The CDL redesigned the EVLA 12–18 GHz amplifier with a waveguide input. The 75–110 GHz phase shifter was prototyped, fabricated, scaled to 17–25 GHz, and tested. Measurements of the K-band (18–26.5 GHz) focal-plane-array feed were completed. On-chip measurements of the new NRAO-designed 35nm InP GHz MMIC LNA made by NGST show 30 dB of gain and 200–250 K noise temperature over 67–95 GHz, the lowest room-temperature noise ever reported at these frequencies.

EPO led NRAO exhibitions at the winter 2008 AAS meeting in Austin, TX and at the 2008 AAAS meeting in Boston. An electronic NRAO Newsletter was designed and will debut in the next quarter. EPO and CIS completely redesigned the NRAO web site. The joint NRAO–West Virginia University Pulsar Search Collaboratory program got underway in January. Through this innovative, three-year program, teachers and students will assist a worldwide team of astronomers in discovering new pulsars.

SCIENCE

SCIENCE HIGHLIGHTS

Very Large Array (VLA)

VLA Galaxy Survey Yields First Results: The HI Nearby Galaxy Survey (THINGS) teams presented the first results of this 500-hour observing project that produced high-resolution image sets of 34 nearby galaxies. Most of the THINGS galaxies also have been observed with Spitzer and GALEX, providing a valuable multiwavelength database. Initial analysis of the results has yielded new insights on the gas-density threshold required to trigger star formation, new details of complex structures in the ISM, the sizes of gas disks in spiral galaxies, and the measurement of non-circular motions in the galaxies that are too small to account for the inability of computer simulations to describe the distribution of dark matter in disk galaxies.

The THINGS project is a large international collaboration led by F. Walter (MPIA), and includes research teams led by E. Brinks (U. Hertfordshire), E. de Blok (U. Cape Town), M. Thornley (Bucknell), and R. Kennicutt (Cambridge).

Very Long Baseline Array (VLBA)

VLBA Movies Reveal New Details of Cosmic Jets: The MOJAVE (Monitoring of Jets in Active galactic nuclei with VLBA Experiments) survey is making a long-term study of 200 galactic jets and now has released time-lapse movies of 100 of these jets. The survey includes polarization measurements that are producing valuable information on magnetic fields in the jets. Some of the galaxies have shown surprising behavior, including 3C279, which emitted a bright feature that moved along a straight path for 15 years, then suddenly brightened, showed a change in its magnetic field, and sped off in a new direction. Other galaxies shoot successive bright features that move outward in curved paths, and some jet features break apart unexpectedly.

The MOJAVE collaboration is led by M. Lister (Purdue).

Green Bank Telescope (GBT)

Physical conditions in star-forming regions: It is frequently difficult to determine the physical conditions in star-forming regions of external galaxies because emission from the most abundant molecular tracer, CO, is generally dominated by radiative-transfer effects. Less-abundant molecules can be better suited for determining the temperature and density of dense gas, although their emission lines can be quite weak and difficult to study. Recently the GBT was used to measure several transitions of H₂CO in a set of infrared-bright starburst galaxies and derive accurate measurements of the density of molecular hydrogen, H₂. The data show a correlation between the infrared luminosity and the derived volume density of H₂ consistent with suggestions that the high infrared brightness of these galaxies is driven by extreme star-formation activity. Moreover, a relationship between the infrared luminosity and the derived total mass of dense gas supports the theory that active star formation in infrared-bright galaxies is driven by the amount of material available to form stars.

Mangum, J.G., Darling, J., Menten, K.M., and Henkel, C. 2008, ApJ, 673, 832.

SCIENCE

1. SCIENCE HIGHLIGHTS

Measuring the composition of the moon: A pure circularly polarized radar signal incident upon the lunar surface will be returned in a mixed polarization state depending on the surface properties. By using the Arecibo radar to transmit a circularly polarized signal and the GBT to receive both reflected circular polarization states, the detailed structure of the reflecting surface can be measured. This was the technique used by Campbell and collaborators to study the lunar Aristarchus plateau, a block of ancient highland crust that rises 2 km above the surrounding basaltic plains. Its visible surface is dominated by pyroclastics, blankets of fine-grained glass and crystal spheroids formed by eruptions of gas-rich magma during the early phases of lunar basaltic volcanism. The distribution, composition, and glass fraction of the pyroclastics offer clues to the opening stages of lunar volcanism.

The data reveal the outlines of a lava-flow complex that covers a significant portion of the plateau and appears to have formed by spillover of magma from a nearby sinuous rille. There is also evidence for a 10 m depth of fine-grained glass as well as numerous patches of rocks, 2 cm and larger, associated with ejecta from the Aristarchus crater. Some of the radar-detected rocky debris is not evident in visible-wavelength images. The new radar data provide a window on the geologic history, resources, and potential hazards of this region.

Campbell, B.A., Carter, L.M., Hawke, B.R., Campbell, D.B., and Ghent, R.R., 2008, Geology, 36, 135.

SCIENCE AND ACADEMIC AFFAIRS

Office of Science and Academic Affairs (OSAA)

The OSAA has been busy this winter supporting the scientific staff by assisting the scientific staff review committees in their annual review process, tracking research travel budgets, reviewing meeting/observing travel requests, and meeting and event planning for the 2008 scientific staff retreat “Future Prospects and Developments at NRAO and in the U.S. Radio Community” and the 2008 NRAO Postdoctoral Fellows Symposium.

Nominations for the 2008 Karl G. Jansky Lectureship award were received during this quarter. The newly formed Jansky Award Selection Committee has reviewed the list of nominations and support materials and will provide their recommendations to the Director. The Karl G. Jansky Lectureship is an honor established by the trustees of Associated Universities, Inc., to recognize outstanding contributions to the advancement of radio astronomy.

The OSAA updated the scientific staff policy and renewed the scientific staff review committees by staggering lengths of terms, nominating new members, and retiring others in time for the spring Performance Review process.

The OSAA changed the policy for Large Proposals and reviewed the status and data releases from the ongoing Large Projects.

Archives

Processing work continues on the papers of John D. Kraus and the personal papers of David Heeschen. We continue to digitize photographs for public access via the online catalog and to digitize Grote Reber materials.

The finding aid to the collection and the Archives online catalog linked from the NRAO Archives home page, <http://www.nrao.edu/archives/>, continues to be updated with additional information.

Library Program

The NRAO Library is currently testing a new *NRAOPapers* database system. The database was developed at the ESO Library by Chris Erdmann and Uta Grothkopf to track ESO telescope papers. Beginning in March and working closely with ESO and the NRAO IT group, we optimized this system and customized it to capture NRAO telescope data, including Proposal Numbers (Project Codes) in support of E2E activities at the NRAO. If the testing phase goes well, we will begin utilizing the database by the end of September, complete with 14,400+ records migrated from the present database.

The Charlottesville and AOC libraries have completed bar coding the circulating, reference, and oversize collections. Self-checkout will roll out at these two sites in the second quarter of this calendar year.

The NRAO Library has accepted the challenge to build the web page (and infrastructure) for NRAO hosting of the International Symposium on Space Terahertz Technology conference proceedings papers. Our staff will also work with the ISSTT conference organizers in 2009 to organize and produce the CDs of the papers for conference distribution.

Scientific Appointments

Arrivals/Promotions

The OSAA was pleased to have four candidates accept Jansky Fellowships for September 2008. The new Jansky Fellows are Esteban Araya, NMIMT; Stuartt Corder, Caltech; Adam Deller, Swinburne University of Technology; and Brian Kent, Cornell. Three of them will be at the NRAO (two in Charlottesville and one in Socorro), and the fourth will be at the University of New Mexico in Albuquerque.

We currently have on staff 12 Jansky Fellows. Four are stationed at the Observatory and eight are at other institutions. There are also 11 NRAO Postdocs or Research Associates based at the Observatory.

Scientific Staff appointments made this quarter include:

- Denis Barkats, Caltech, accepted an ALMA Commission Scientist position for the NA ALMA Science IPT to be stationed in Santiago, effective January 1, 2009.
- Violette Impellizzeri, MPIfR, accepted a Research Associate position on the Megamaser Cosmology Project working with Jim Braatz in Charlottesville. She will begin this summer.
- Anthony Remijan, Research Associate, received and accepted a position as an Assistant Scientist to work on the NAASC in Charlottesville. He will begin this appointment in June.
- Dr. Robert Reid, Research Associate, received and accepted an offer for a project appointment as an Assistant Scientist working of the ALMA and EVLA projects effective June 1.
- Rachel Rosen, UNC, Chapel Hill, accepted a Research Associate appointment at the NRAO in Green Bank serving as the Project Director for the Pulsar Search Collaboratory project and will begin in May.

Departures/Extensions

J. P. Macquart will complete the six-month extension of his Jansky Fellowship on May 31. He has taken a position at Curtin University of Technology in Australia.

Student (Graduate and Co-op) and Visiting-Scientist Programs

Pre-docs

Esteban Araya (New Mexico Tech) completed his Ph.D. on formaldehyde maser emission in the Galaxy working with Miller Goss at the Array Operations Center and co-supervised by Prof. Peter Hofner at New Mexico Tech. Alok Singhal (University of Virginia) completed his Ph.D. on the connection between galaxy kinematics and HI line widths as applied to the distance scale, working with Rick Fisher in Charlottesville and co-supervised by Karen O'Neil in Green Bank and by Prof. Ed Murphy at the University of Virginia. Urvashi Rao-Venkata (New Mexico Tech) began a pre-doctoral appointment working with Frazer Owen in Socorro investigating parameterized deconvolution in radio synthesis imaging, specifically for high-dynamic-range and multi-frequency imaging with the EVLA, co-supervised by Prof. Jean Eilek at New Mexico Tech. Chataili Parashare (University of Virginia) continued working with Richard Bradley at the NRAO Technology Center on instrumentation for low-frequency radio astronomy arrays.

SCIENCE

2. Science and Academic Affairs (SAA)

Graduate Interns

Alyson Ford (Swinburne University) again worked with Jay Lockman in Green Bank analyzing the distribution, structure, and properties of HI clouds above the Galactic plane. Rosa Torres Lopez (UNAM-Morelia) worked with Amy Mioduszewski in Socorro on VLBA astrometry of young stars. Bill Peterson (U. Iowa) worked with Miller Goss in Socorro on preparations for VLBA/HSA mapping of Algol. Jorge Perez-Gallego (University of Florida) worked with D.J. Pisano in Green Bank on comparing optical spectroscopy with GBT and VLA data for galaxies.

Co-op Students and Engineering Interns

Colin Frentzel, an electrical-engineering major at Missouri University of Science and Technology (formerly UM-Rolla), began a co-op assignment in Socorro with Dan Merteley and the Interference Protection Group at the VLA site.

Visiting Scientists

Dr. Malcolm Gray (University of Manchester, U.K.) continues a sabbatical year in Socorro working on theory and computational models associated with astrophysical masers.

REU/Summer-Student Program

The 2008 NRAO summer-student research program recruited 23 students—eight at Socorro (4 REU, 1 undergrad, 3 grad), four at Green Bank (4 REU), and 11 at Charlottesville (8 REU, 2 undergrad, 1 grad). The program offers 10–12 week appointments and students begin to arrive mid May.

Support Programs

Student Observing Support (SOS)

In FY 2008 we have \$330k in funds to support student observing on NRAO instruments (for details, see <http://wiki.gb.nrao.edu/bin/view/Observing/NRAOStudentSupportIntro>). Approximately one quarter of these funds are available for allocation to qualifying trimester 08A proposals. The Student Support Committee met in January 2008 and recommended funding the following four proposals:

BM267, “Time-Lapse Imaging of Algol's Radio Magnetosphere”
Student: William M. Peterson / Supervisor: Robert Mutel (\$35,000)

GBT08A-056, “Observations with MUSTANG on the GBT at 3.3 mm”
Student: Phil Korngut / Supervisor Mark Devlin (\$20,427)

GBT08A-082, “Probing Distribution and Physical Characteristics of HI Clouds in Galaxy Halos”
Student: Sanchayeeta Borthakur / Supervisor: Min Yun (\$17,500)

GBT08A-081, “HI Brightness Mapping of DEEP2 Fields”
Student: Kevin Bandura / Supervisor: Jeff Peterson (\$17,500)

TELESCOPE USAGE

The NRAO telescopes were scheduled for research and for maintenance during the first quarter of 2008 as described in the table below. Time lost and actual observing for the arrays are computed as fractions of the total antenna arrays. For example, losing 27 VLA antennas for one hour counts as 1.0 hours of array time lost, while losing one out of ten VLBA antennas for one hour counts as 0.1 hours of array time lost. Antennas being modified for the EVLA and therefore not available for astronomical observations are counted as lost for observing.

We now schedule approximately 40% of the VLA time dynamically, prototyping our dynamic scheduling process for the EVLA. There are voids in this process creating unscheduled periods because we do not always have programs of the right length in the right range of sidereal times to fill in the gaps in the schedule. This is particularly true during the 6–8 weeks each year when antennas are being moved because the mixed VLA configurations are not useful for the majority of our astronomical observations. In addition, EVLA testing and commissioning now takes priority for dynamic time, especially at short notice. The EVLA testing sometimes fills part of a dynamic scheduling slot in such a way that there is no corresponding astronomical observation available to fill the rest of the slot.

There are three primary factors that create unscheduled periods for the VLBA.

- (1) Both dynamically scheduled and fixed-schedule VLBA projects are typically 10–16 hours in length; with only 10 antennas, the VLBA cannot effectively take snapshots. The lack of scientifically compelling proposals that last for only 2–4 hours means that gaps of this length usually cannot be filled by dynamically scheduled programs, so the VLBA is idle for such periods.
- (2) The VLBA observing rate is limited by the disk module supply, which is sufficient only for a 128 Mbps sustained recording rate with a module turnaround time of about 30 days. Because the best science typically requires more sensitivity, as many as 70% of the VLBA proposals now request 256 Mbps or 512 Mbps data rates; these proposals can be accommodated (and the correlator can keep up!) only if we leave gaps in the schedule.
- (3) We have at least three scheduled 1–2 week maintenance visits per year to a VLBA station. There are significant gaps in the schedule during those periods because most programs require at least nine working antennas to have effective imaging capability. We have neither the personnel nor the hardware available to visit multiple antennas during the same week.

Telescope Usage (hours)			
Activity	VLA	VLBA	GBT
Scheduled Observing	1559.06	933.00	1878.00
Scheduled Maintenance and Equipment Changes	195.50	234.00	173.00
Scheduled Tests and Calibrations	413.34	329.75	133.00
Time Lost	16.10	62.10	117.00
Unscheduled	298.41	662.25	–
Actual Observing	1542.96	870.90	1761.00

PROJECTS

1. Expanded Very Large Array

PROJECTS

EXPANDED VERY LARGE ARRAY (EVLA)

EVLA highlights for the quarter include:

- Fifteen antennas have been retrofitted to the EVLA design and account for 51.7% of all antenna hours in scientific observations.
- The production lamination of the S-band feed horns was initiated.
- The correlator chips were delivered by the chip manufacturer.
- A schedule was developed for the transition of the EVLA construction project to operations.
- The upgrade of the T304 downconverters for the EVLA's wideband signal path was started.

Management

The WBS cost data sheets and risk register for the EVLA project were updated during the quarter. Project contingency is \$3.45M, or about 18.5% of the estimated cost to complete the project. The percentage contingency remains at historically high levels. However, contingency is expected to decrease because additional resources are needed in the front-end group to address its protracted schedule.

Per the recommendation of the EVLA Advisory Committee and the AUI Visiting Committee, an integrated schedule was developed to illustrate how the EVLA construction project transitions to operations. The schedule shows how the required software and hardware come together in preparation for the first shared-risk science observations with the new telescope. The schedule was used to develop an EVLA Capabilities Forecast that will be updated on a quarterly basis.

A draft EVLA Operations Plan was written in May 2007. The plan estimates the staff needed to operate the EVLA. As part of the transition schedule discussed above, the Operations Plan is being reassessed based upon recent experience with operating and maintaining the EVLA antennas. A revised plan will be used to identify future staffing needs.

A meeting was held at the DRAO in Penticton, BC in February to review management processes for the WIDAR correlator. The meeting adequately addressed NRAO's concerns regarding the use of formal management tools in the execution of the WIDAR project, the support of DRAO's funding agency, and the routine involvement of WIDAR project management.

The EVLA change control board approved a request to extend a person on the project budget to complete the retrofitting of the EVLA antennas. Another request to supplement the materials and services portion of the LO/IF WBS was also approved. Additional change board requests for additional staffing and funds to support the production of EVLA receivers were also reviewed. These requests were tabled to allow for more accurate cost estimates to be made.

Systems Integration

The electronics outfitting of the 14th and 15th EVLA antennas was completed. All 15 antennas are used in routine observations. In March 2008 they accounted for 51.7% of all antenna hours in scientific observations.

PROJECTS

1. Expanded Very Large Array

Work continues on studying the unexplained relationship between the phase of the antenna signal and antenna elevation. A more suitable signal-injection technique was implemented to produce faster and more repeatable results during antenna testing. Laboratory tests were completed on modules in the data-transmission system to eliminate the digitizers as a potential cause. Another test was run to exonerate the system software and VLA correlator. These tests confirmed that the issue is indeed in the antenna portion of the LO/IF electronics system. Tests are currently concentrating on the thermal behavior of the LO comb generator (a commercial product) and a circuit board in the downconverters.

The central LO system has been updated to add the timing and clock signals necessary to support the testing of the WIDAR prototype correlator that will begin in the summer of 2008.

Civil Construction

The humidity control features of the HVAC (heating, ventilation, and air conditioning) units in the correlator's shielded room were placed in operation in March 2008.

The civil construction WBS element of the EVLA project is basically complete. The only work remaining for civil construction is to assist the Electronics Division with the installation of the WIDAR correlator in the new shielded room, install control and alarm wiring for the air conditioning equipment in the shielded room, and activate the FM200 gas cylinders in the fire suppression system of the shielded room once the correlator is installed.

Antennas

The mechanical overhaul of the 14th and 15th EVLA antennas was completed. The mechanical overhaul of the 16th antenna is nearly complete.

The assembly and fiberglass lamination of the L-band (1–2 GHz) feed horns will be complete this year; 27 have been assembled and laminated to date.

Production orders were placed for the S-band (2–4 GHz) feed horn's centrifugal castings and fiberglass lamination in February 2008. The production lamination of the S-band horns started in April. The horns will be assembled at the rate of two every seven weeks. The fabrication of the aluminum rings for the S-band horns continues at the VLA site.

Two prototype horns were fabricated for the Ku-band (12–18 GHz) receiver. Their RF performance will be evaluated in the summer of 2008.

Front End

During the past quarter, the 15th EVLA antenna was outfitted with interim L-, C-, and X-band receivers as well as fully EVLA-compliant K-band and Q-band systems. The current status of each receiver band is summarized below.

L-band: The mechanical drawings for the new design of the L-band (1–2 GHz) dewar were completed. A vendor that can supply cast dewars that comply with the vacuum requirements has been identified. A request for quotation for the prototype dewars is being prepared.

PROJECTS

1. Expanded Very Large Array

The fin-and-clamshell profile for the quad-ridge sections of the orthomode transducer (OMT) was revised. Also, a shorting block will be used in the throat section of the OMT instead of the shorting pins that were part of the original OMT design. The block is easier and cheaper to manufacture than the shorting pins. In numerical simulations, the combination of the revised profile and shorting block gives a return loss that is 5 dB better than specification and improved broadband performance overall. These refinements to the OMT are being tested.

S-band: The design of the new quad-ridge OMT for the EVLA S-band (2–4 GHz) receiver was completed in Green Bank. This effort involved the scaling in frequency of the current designs for the L- and C-band OMTs. Machinist drawings of the OMT were generated, and two prototype OMTs were fabricated in December 2007. The OMTs were shown to meet project specification in January 2008. The old VLA L-band dewar will be reused for the new S-band receiver, and drawings are being made to document the required dewar modifications. The completion of a prototype S-band receiver is slated for Q3 2008.

C-band: The construction of interim C-band (4–8 GHz) receivers is currently ahead of the antenna retrofitting schedule. The first fully EVLA-compliant C-band receiver will be installed on antenna 3, the 17th antenna in the retrofitting sequence.

The initial version of the quad-ridge sections for the prototype C-band OMT meets project specifications. However, its assembly and adjustment are time consuming. The refinements made to the L-band quad-ridge OMT have proven to be scaleable to the C-band unit, and laboratory measurements show that the performance of the revised fin profile exceeds specifications. The refinements simplify the assembly of the OMT such that no adjustments are required after the assembly of the device for it to meet its performance specifications.

The OMT is combined with a 90 degree hybrid coupler to convert linear polarization into circular. It requires the cables between the OMT and hybrid to be phase matched, which was recently accomplished. A hybrid that functions reliably at cryogenic temperatures was selected.

X-band: The X-band (8–12 GHz) receiver is still in the design and prototype stages. Engineering staff in Green Bank are developing a four-probe, planar-style OMT for the receiver. Test data show that the OMT is providing acceptable performance for this type of design. Current work on this OMT is focused on its 90 and 180 degree hybrid sections. The noise contribution of the planar OMT may be too large, so the Central Development Laboratory is working on an all-waveguide OMT as well.

Ku-band: The RF and mechanical designs of the Ku-band (12–18 GHz) receiver are complete. The OMT, phase shifter, and square-to-rectangular waveguide transition were scaled from the design of the K-band receiver. Full production of the Ku-band receivers will start in late 2009.

Ka-band: The prototype Ka-band (26–40 GHz) receiver meets specifications, but it has shown an additional 2 dB conversion loss in its downconverter. Tests are underway to determine the origin of the additional loss. The second pair of downconverters has been assembled and is undergoing tests in the lab. The prototype Ka-band receiver is scheduled to be installed in the array in May 2008. The mass production of this receiver will begin in Q3 2008.

K-band and Q-band: The installation of EVLA-compliant K-band (18–22 GHz) and Q-band (40–50 GHz) receivers is keeping pace with the antenna retrofitting schedule

PROJECTS

1. Expanded Very Large Array

Local Oscillator (LO) and Intermediate Frequency (IF) Systems

Modules for the LO and IF systems of the EVLA continue to be built to meet the antenna retrofitting schedule. Some modules require retrofits for hardware upgrades and RFI considerations. The module retrofits will be made so as not to interrupt the antenna retrofitting schedule.

The production of the L352 round-trip phase module had been delayed by some design issues. The L352 has been shown to meet its design specifications, and its full production was started in February 2008. Production of the module has actually been accelerated so that L352 capability can be provided to the retrofitted antennas now in use.

The EVLA antennas currently in the array use the EVLA's narrowband (1 GHz) signal path. The full capability of the EVLA's wideband (2 GHz) signal path cannot be exploited until the arrival of the WIDAR correlator. The first T304 baseband converter modules to be fully configured with wideband electronics are now being produced. The parts needed for the wideband path, such as the gain-slope equalizers and wideband filters, have been received and are now being included in the regular production build. The wideband upgrade of existing T304 modules will commence this summer.

Some LO/IF modules have not met phase-stability requirements because of thermal effects in the modules. The phase stability of these modules is being improved by adding thermal mass and by replacing existing module cables with cables that are less sensitive to temperature variations. Investigations into module phase stability will continue in an attempt to identify any other problems, particularly in the course of testing the wideband signal path with the new correlator.

The final procurement of parts for all LO/IF modules is underway and will be completed by the end of the calendar year. All LO/IF modules are scheduled to be complete by the fourth quarter of FY 2009.

Fiber Optic System

Modules for the digital transmission system (DTS), formatter, and deformatter continue to be built to meet the antenna retrofitting schedule. The deformatters are actually being built ahead of the antenna retrofitting schedule for the testing of the prototype WIDAR correlator. Likewise, the assembly of the high speed 3-bit sampler is planned to meet the testing of the WIDAR correlator once its installation is complete by October 2008. Retrofitting DTS modules with the 4 Gbps sampler will continue at the rate of one antenna per month.

A detailed schedule was developed for installing the infrastructure for the WIDAR correlator. The 4-station prototype will be installed in early June, and prototype tests will be conducted through September 2008. The racks and cables for the full correlator will be installed in May through September. Limited observing with a 10-station correlator will commence in late September. Access, cleanliness, and electrostatic discharge (ESD) procedures will be implemented in the correlator shielded room in early October.

PROJECTS

1. Expanded Very Large Array

Correlator

The past quarter has been devoted to extensive testing of the “stage 2” prototypes of both the station board and the baseline board. The station board provides delay tracking and digital filtering for the correlator. The baseline board contains the correlator chips where the correlations are computed. The final design of the station board has been approved, and the “stage 3” build of 14 station boards has begun. These boards should be delivered by the end of May 2008. Testing of the baseline board is still underway and has gone very well. The board is functioning as designed. However, some bugs have been encountered in the baseline board, and this has delayed the approval of the design for its next stage build. Current estimates suggest that the stage 3 build of the baseline boards will begin in May, with delivery in July in time for the population of the 10-station prototype correlator in August/September. This does not delay critical on-the-sky tests with the 4-station prototype correlator in June, as the existing stage 2 baseline boards can be used.

The correlator chip manufacturer, iSine, delivered the first set of 1200 chips in late March 2008 and the second set of 10,800 chips in mid-April. The first set of chips is being used for qualification testing and for the prototype correlator boards. 275 of these chips were tested in the 266 MHz functional standalone tester, and all but one (0.4%) passed the tests. Anticipated failures based on raw yield and scan test coverage were estimated at 1.6%. 100 chips and a standalone tester were sent to MuAnalysis, a company that specializes in industry-standard integrated circuit qualification, failure analysis, and screen testing for device qualification to relevant standards. The remaining chips will be used to populate the stage 3 build of the baseline board in June. The second set of chips will also be tested and should be available in the summer, well in advance of final board production.

Production and assembly of the correlator racks is proceeding. The first eight racks will be delivered to the VLA site by May 30th, and the remaining eight racks will be delivered by the end of July. All of the rack-to-rack high-speed cables have been delivered to the VLA site. DRAO personnel will be at the VLA site in June and August to oversee the rack and cable installation. Real-time software, as well as backend and control software seems to be converging with the hardware delivery schedule. Therefore, when hardware is delivered to the VLA site, software will be available to run it. A test bed consisting of a station board and a baseline board has been assembled in Penticton for the sole purpose of testing software. The test bed will allow a significant amount of testing to occur prior to hardware arriving at the VLA site in June.

Monitor and Control (M&C)

The work of the EVLA M&C group continues to be divided among three major areas: (1) maintenance of the transition observing system, (2) work on the EVLA antenna M&C system, and (3) work on the EVLA correlator M&C system.

Transition observing continued to operate smoothly during the quarter. Software and scripts were written to allow users to submit concatenated OBSERVE files for observing in separate VLA and EVLA sub-arrays during dynamically scheduled observations. There was a new release (v1.4.2) of the Alert Server during the quarter. Changes were made to improve the performance of alert handling within the EVLA operators’ software. The main difference is the alert descriptions and actions are no longer sent by default to a client, dramatically reducing the amount of data sent to the client. If a client requires this information, it can be obtained by a request to the Alert Server. There were also two new standard releases of the EVLA Operators Software. The first release (v1.4.0) added three new screens: TPD (Total Power Detector screen), ANT_PS (EVLA antenna power-supply screen), and ANTS_PS (power-supply screen

PROJECTS

1. Expanded Very Large Array

for all EVLA antennas). The second release (v1.5.0) included changes to the Alerts Screen, making it compatible with version 1.4.x of the Alerts Server. There were also two minor releases (v1.4.1 and v1.5.1) that included minor feature additions and bug fixes.

Work on the EVLA antenna M&C system revolved around new software on the module interface boards (MIBs) for the L350 central reference generator and the L351 master offset generator. In addition, an important software bug related to inaccurate floating-point arithmetic on the MIBs was found and fixed. The bug was causing an incorrect frequency calculation in addition to other oddities. A decision must be made in the coming six months on whether to accept the work-around fix of the bug or to get a new version of the operating system for the MIBs that is free of this defect. Work on the MIBs for the weather station and atmospheric phase interferometer (API) will occur in the coming six months.

Work progressed on the WIDAR M&C system in preparation for the delivery of the 4-station prototype correlator (PTC) in June 2008. A document describing all of the software needed for both the PTC and the 10-station early WIDAR was started. The document should be complete in the next quarter. A startup sequencer and a related graphical user interface (GUI) for setting it up were created for the WIDAR baseline boards. A Linux kernel module to serve as the driver for the National Instruments PCI-6509 data-acquisition card in the CPCC (Central Power and Control Computer) was written and tested. It works quite well. The design and implementation of the Test Builder and Test Executor were started. This software will be necessary to set up the PTC for testing. An agreement between ALMA and EVLA on the binary data format (BDF) has been written. Existing code will be modified to write this version of the BDF over the next few months. The writing of the minimal version of the Science Data Model (SDM) that will be needed for testing of the prototype correlator has progressed to the point where real SDMs are being written to disk given current input on what the VLA is doing. Further refinement of interfaces for quantities and tests of different modes of operation will continue in the coming quarter in preparation for the delivery of the PTC.

Science Support Systems (SSS)

Over the past quarter, the efforts of the Science Support Systems (SSS) group were split between the long-term goal of providing new tools for EVLA observing and the short-term goal of supporting Ka-band observing with the existing VLA correlator. Most of the work, however, supported both goals simultaneously.

Work was completed on the parminator, and operator training on this important software tool has begun. The parminator is a web-based interface used by operators to maintain many of the parameters essential to the operation of the EVLA. In addition to supporting some new parameters, the tool now has a much more rigorous error-checking and handling mechanism and a method for batch input from a file, which is vital for pointing and baseline results. Maintenance and enhancement of the tool and additional training on it will continue in the upcoming quarter.

An expert-user interface for manipulating the EVLA antenna electronics was made available within the Observation Preparation Tool (OPT). Users who do not wish to deal with the instrument at such a detailed level will be shielded from this part of the application. Expert users, though, will be able to tune each local oscillator independently and will eventually have access to all hardware switches.

The OPT was augmented in two other areas. The first augmentation was the creation of a summary tab for scheduling blocks that shows a listing of the scans in that block. To support this tab, an underlying model that includes the EVLA telescope motion model and celestial coordinate conversions had to be updated.

PROJECTS

1. Expanded Very Large Array

The second augmentation was the addition of software that converts the project model into a script of commands (in the *jython* scripting language) that can be understood by the current observation executor. This ability is in the prototype stage and can currently handle only the simplest of observations. More work will be done on this part of the software in the upcoming quarter.

Work has progressed on adding a model and user interface for the VLA correlator to the SSS software in order to support Ka-band observing on the VLA. The user interface will be similar to the one presented to users in the Proposal Submission Tool (PST). Scientists reviewed the interface, and their suggestions are being implemented in an updated version of it. An assessment on the feasibility of using the new OPT for Ka-band observing in the fall of 2008 will be made soon. While a decision has yet to be made, preliminary indications are that the tool should be ready in time.

The design for archiving visibility data from the prototype WIDAR correlator was further developed. A deployment diagram was developed, and its implementation is underway. The deployment includes Next Generation Archive Systems (NGAS) at the VLA and AOC and the means for staff scientists to access the data through an interface similar to the one used currently for retrieval of data from the VLA and VLBA archives. Further design and testing work on how well this current architecture will scale to the 10-station and final WIDAR correlators will occur in the next quarter.

EVLA Milestones

Milestones	Original Date	Revised Date	Date Completed
1. EVLA Science Data Model (SDM) review to ALMA	08/10/07	01/03/08	01/03/08
2. WBS, earned value, and risk register updated	01/14/08		01/14/08
3. Start EVLA conversion of antenna 5	01/17/08		01/17/08
4. Develop requirements for EVLA-designed weather station	11/01/07	01/15/08	02/11/08
5. Complete lab tests of prototype Ka-band receiver	01/10/08		03/24/08
6. Science Data Model, v 1.00 published	12/31/07	07/07/08	
7. Calibration Data Model, v 1.00 published	12/31/07	04/14/08	
8. RF design of S-band receiver completed	01/31/08		02/04/08
9. RF design of Ku-band receiver completed	02/14/08		02/14/08
10. S-band receiver OMT design completed	02/19/08		02/19/08
11. Hardware acceptance tests completed on antenna 1	02/04/08		02/21/08
12. Antenna 1 Turnover to Operations	02/05/08		02/22/08
13. L-band dewar drawings ready for fabrication	11/08/07	02/11/08	03/07/08
14. OPT outputs an EVLA observe script	10/25/06		03/13/08
15. Binary Data Format, V 1.00 published	03/14/08		03/14/08
16. Start EVLA conversion of antenna 2	03/18/08		03/18/08
17. Delivery of high-speed cables from Penticton	12/18/07	03/03/08	03/25/08
18. Begin retrofits of T304 modules	03/07/08		03/27/08
19. Report on RTP measurement resolution limits	01/25/08		03/28/08
20. 1 st production Ka-band receiver installed	03/03/08	04/03/08	

PROJECTS

1. Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
21. C-band OMT—broadband test in receiver	08/31/06	04/04/08	
22. Complete production design of C-band OMT	04/27/07	04/04/08	
23. Hardware acceptance tests completed on antenna 5	04/10/08		
24. Antenna 5 Turnover to Operations	04/11/08		
25. Complete production design of the C-band OMT	03/14/08	04/11/08	
26. L-band receiver OMT design completed	04/15/08		
27. Install wideband C-band receiver on antenna	11/02/06	04/17/08	
28. T301 solar attenuators tested on one antenna	02/29/08	04/17/08	
29. Shutdown old MODCOMP computers	04/21/08		
30. Begin production of C-band OMT	02/28/07	05/01/08	
31. S-band receiver OMT design completed	05/13/08		
32. Delivery of correlator racks from Penticton	03/18/08	05/15/08	
33. Start EVLA conversion of antenna 3	05/15/08		
34. Implement correlator room cleanliness procedures	05/29/08		
35. Start correlator rack and cable installation at VLA site	05/30/08		
36. 4-station board correlator delivered to VLA site	06/09/08		
37. Hardware acceptance tests completed on antenna 2	06/10/08		
38. Antenna 2 Turnover to Operations	06/11/08		
39. Circuit-board design review for new DDS	06/16/08		
40. 1 st article 3-bit sampler chip on-board test completed	06/30/08		
41. L-band receiver OMT tests completed	11/15/07	07/01/08	
42. Start critical on-the-sky testing w/ 4-station prototype correlator	07/02/08		
43. Science Support System software PDR	06/05/07	03/26/08	
44. Correlator room access control implemented	12/05/07	09/09/08	
45. Complete waveguide-style design of X-band receiver	01/15/08	10/08/08	

PROJECTS

2. New Initiatives

NEW INITIATIVES

Square Kilometer Array (SKA)

The first meeting of the Antennas Working Group for the U.S. Technology Development Program (TDP) for the SKA took place in March 2008. Three individuals from the NRAO attended the meeting, which focused on presenting initial work plans as well as preliminary results of ongoing studies. Two of the key results were (1) it is very difficult to optimize a single antenna system for the wide range of key science programs being put forth by the science community; and (2) in order to procure an initial SKA antenna system by the end of the TDP in 2011, decisions about the specifications of this system need to be made in 2009.

The NRAO also played an extremely active role in the U.S. SKA Consortium planning group for the upcoming U.S. decadal survey. An overall approach will be agreed to and proposed to the U.S. Consortium at their meeting in May 2008, when Consortium officers and international representatives for the next three years will be elected.

VLBI Space Observatory Programme-2 (VSOP-2)

A NASA Mission of Opportunity proposal was submitted in January for a U.S.-led key science program associated with the VSOP-2 spacecraft, which is scheduled for launch in 2012. The proposal has two primary scientific components—repeated imaging of the strongest gamma-ray blazars and astrometric imaging of extragalactic water megamasers in order to refine the value of the Hubble constant. This proposal had a JPL PI and two NRAO co-investigators, and it includes a significant budget for VLBA operations as well as the cost of preparing for VSOP-2 support. We anticipate that NASA will downselect from 16 proposals to a few candidates that will undergo Phase A studies before a final selection; this initial downselection is expected during the 3rd quarter of 2008.

External Partnerships

The implementation of improved 22 GHz systems on the VLBA, funded by the Max Planck Institut für Radioastronomie, was completed during the first quarter, and achieved the expected improvement of over 30% in sensitivity. A final report will be completed in the 2nd quarter of 2008.

Allocation of NRAO observing time took place for Cycle 1 of the GLAST (Gamma-ray Large Area Space Telescope) Guest Investigator program. Approximately 300 hours of VLBA time were awarded, along with slightly less than 100 hours of GBT and VLA time. At this writing (early May 2008), GLAST launch is on a temporary hold due to launch-vehicle problems. Launch still may take place during the 2nd quarter of 2008 or may be postponed somewhat, pending the resolution of the launch-vehicle issues.

NRAO representatives attended a two-day symposium covering all aspects of NASA spacecraft navigation in both near-Earth and deep-space environments. At this meeting a plan was initiated to perform high-accuracy VLBA navigation of the Phoenix spacecraft at its Mars encounter in May 2008, including navigation relative to Mars orbiters with accuracy of tens of micro-arcseconds. A series of approximately ten observations was planned, the first in March and then with increasing frequency throughout May until the encounter on May 25. The first test observation of Phoenix and the orbiters was carried out in March 2008.

PROJECTS

2. New Initiatives

Frequency-Agile Solar Radiotelescope (FASR)

FASR is a priority facility designed to address solar, heliospheric, and space-weather physics. The project was developed by a partnership under AUI management that includes the NRAO and a number of university partners: NJIT, UC Berkeley, the University of Michigan, the University of Maryland, and Caltech. A letter of intent was signed by the partners in August 2007, and a preliminary proposal was prepared and submitted to the National Science Foundation division of Atmospheric Science in response to the Mid-Sized Infrastructure Opportunity in January 2008.

AUI, the NRAO, and the university partners signed a teaming agreement in spring 2008 for the purpose of submitting a full proposal for FASR construction to the MSI Opportunity program. FASR was indeed invited to submit a full proposal. The FASR team will prepare and submit a proposal for \$25M in funds in June 2008. If FASR is selected for an award, a funding start by the end of the first quarter of FY 2009 is possible.

New Initiatives Office Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Submit NASA MoO proposal for VSOP-2 support	01/15/08		01/15/08
2. Attend NASA Navigation Workshop	01/24/08		01/24/08
3. NRAO-NM planning meeting for decadal survey	02/07/08		02/07/08
4. Support first meeting of AUI Operations review	03/01/08		03/01/08
5. SKA Science and Engineering Committee meeting	04/08/08		
6. First meeting of VSOP-2 International Steering group	05/13/08		
7. U.S. SKA Consortium meeting, elections	05/22/08		
8. Complete VLBA observations of Phoenix	05/26/08		
9. Phase A downselection for VSOP-2 MoO proposal	09/15/08		
10. Submission of preliminary proposal to the MSI Opportunity	01/10/08		01/10/08
11. FASR team invited to submit full proposal to the MSI Opportunity	03/31/08		03/31/08
12. FASR teaming agreement signed by partner institutions	04/01/08		
13. FASR proposal submitted to MSI Opportunity	06/01/08		

OPERATIONS

1. Green Bank Operations

OPERATIONS

GREEN BANK OPERATIONS

Green Bank Operations highlights for the quarter include:

- Successful commissioning of the MUSTANG 90 GHz bolometer array.
- Initial MUSTANG science observations.
- MUSTANG obtained out-of-focus holography maps for telescope surface characterizations.
- Successful astronomical observations with the Zpectrometer backend.
- Creation of new servo control system specification within the Precision Telescope Control System project.
- K-Band focal-plane array conceptual design review completed.
- Dynamic scheduling developed for summer trimester beta testing.

The MUSTANG 90 GHz bolometer array, a collaborative project among the NRAO, the University of Pennsylvania, NASA, and NIST, was installed on the telescope in December and over the course of the quarter underwent multiple successful astronomical commissioning tests. Data obtained during commissioning are being used to characterize the performance of MUSTANG and of the GBT, and to develop and refine data-analysis algorithms. Instrumental sensitivity and vibrational isolation improved substantially over the previous season, and the cryogenic performance of the receiver has been excellent. The Green Bank software division delivered and tested the core functions of the M&C manager for MUSTANG, concluding with a trial observing run. Initial policies and procedures were developed in anticipation of a call for proposals for scientists to use MUSTANG on a “shared risk” basis during the 2008/2009 winter observing season. Given the highly successful commissioning work, preliminary science observations were added to the schedule, resulting in the first MUSTANG images of the Crab Nebula and the Orion K region. Work is underway to deliver an improved detector array (a more sensitive, direct replacement for the current array) for summer testing at the University of Pennsylvania, possibly for use in the system long-term.

The Zpectrometer is an ultra-wide-bandwidth (14 GHz) spectrometer designed to work with the 26–40 GHz cross-correlation receiver on the GBT; it was designed and built by the University of Maryland. During this quarter astronomical commissioning of the Zpectrometer was completed, and initial science observations were begun. The system will be released for shared-risk observing in Q4 of 2008.

The Precision Telescope Control System (PTCS) project achieved full staffing and continued to deliver on schedule. The quarterly meeting with the GB Head of Program Development and the AD for GB Operations refined the priorities and staging of the project deliverables. A series of X-band pointing measurements obtained during cold weather extended the range of thermal conditions covered by the pointing database following the azimuth-track refurbishment. The out-of-focus holography (OOF) team used data obtained during MUSTANG observations to compare the OOF maps from MUSTANG to contemporaneous Q-band maps. Initial results are promising, and the MUSTANG maps are expected to improve as additional data-analysis and data-acquisition efforts are explored. This work, combined with the speed advantage of MUSTANG’s multiple pixels, advances the PTCS goal of automating the procedure to make OOF available as a user tool so observers can do active-surface corrections quickly over the course of an observing session.

OPERATIONS

1. Green Bank Operations

Within the PTCS project the construction of the prototype laser range finder unit nears completion, and proof-of-concept testing will continue through the summer. A decision is expected in late 2008 on construction and deployment of the range finders as a backup to traditional holography and OOF holography for characterizing and correcting the antenna surface. The PLC interlock project will deliver the Az/EI component in May if sufficient on-telescope testing time is available. Modeling the structure and analyzing the collected data to characterize the servo-oscillation problem continues, with a solution for this potentially complex problem expected early in Q3 of 2008 or possibly integrated into the servo replacement project. The servo-replacement project team is creating the advanced modeling of the existing structure, potentials solutions, and has already created a specification for the replacement servo system.

A conceptual design review covering the science case, observing modes, and hardware component designs was successfully completed for the K-band Focal Plane Array receiver (KFPA). The feed was designed, manufactured, and measured for performance; it meets the theoretical predictions. The noise module was prototyped this quarter and parts were selected for the design. The LO distribution, integrated downconverter design, and dewar design were modeled.

The new GBT Dynamic Scheduling System (DSS) project made significant progress on the software for the upcoming DSS beta tests during the summer trimester (June–Sept 2008). Development work includes calendars to show upcoming observing projects and sessions, a web-based interface for investigators to view and update their project and session information, and implementing RSS technology for astronomer notifications. The software now allows for complete testing of the DSS system over a given trimester or year (using historical weather data). Data imports from the NRAO Proposal Submission Tool (PST) have been implemented, so observers only need update their project information in one place. Up-to-date information on the DSS can be found at <http://www.gb.nrao.edu/DSS>.

Configurable Instrument Collaboration for Agile Data Acquisition (CICADA) work concentrated on developing the Green Bank Ultimate Pulsar Processing Instrument (GUPPI). Work continued on the first version of the machine, completing the sampler module, the fast Fourier transform module, and the signal-combining and transmitter blocks. Other CICADA activity included distributing information to external collaborators and creating abstracts for presentation of our research results at URSI and UC Berkeley's CASPER workshops this summer.

In addition to GBT work, development of externally funded activity to utilize the otherwise idle 43 meter telescope continues with implementing MIT/Lincoln Labs' spacecraft tracking schedule by automatically tracking log files, initiating a project with MIT/Lincoln Labs and Haystack Observatory to study the Earth's ionosphere, and implementing a real-time trajectory interface to the 43 m telescope.

GB Site Milestones for FY 2008

Milestones	Original Date	Revised Date	Date Completed
Dynamic Scheduling¹			
1. Stage II tests begin	08/15/07	06/01/08	
2. Stage II tests complete	09/30/07	09/30/08	
3. Design Review	12/01/07	12/01/08	
4. Release Stage III software for general use	06/01/08	10/01/09	
CICADA²			
1. Next Generation Pulsar Machine Phase 1 (Spigot	01/01/08	04/01/08	

OPERATIONS

1. Green Bank Operations

Milestones	Original Date	Revised Date	Date Completed
Replacement)			
2. Next Generation Pulsar Machine Phase 2 (Coherent Machine)	06/30/08	08/30/08	
3. Next Generation Pulsar Machine Phase 3 (Common User Machine)	06/30/08	08/30/09	
4. Design Study for an array spectrometer	09/30/08		
K-BAND FOCAL PLANE ARRAY			
1. System design complete with conceptual design review acceptance	01/15/08	02/15/08	03/19/08
2. M&C hardware module with support software complete	05/13/08	08/01/08	
3. Single-pixel construction complete	05/08/08	08/01/08	
4. Single-pixel testing complete with critical design review acceptance	08/08/08	11/01/08	
MUSTANG³			
1. Document results from second engineering run	03/30/08		03/30/08
PTCS⁴			
1. Trajectory generation and servo improvements	12/31/06	03/30/08	03/30/08
2. PLC interlock system main servo complete	08/31/07	05/16/08	
3. PLC interlock system complete	08/31/07	08/31/08	
4. Laser rangefinder V2 development complete	09/31/07	06/30/08	
5. Recommission the traditional-holography receiver	04/01/08	06/01/08	
Zspectrometer⁵			
2. Science validation complete	06/01/08		

Notes:

1. Dynamic-scheduling work was delayed by work on the high-frequency receivers.
2. CICADA (FPGA Development Project) is a University Collaboration with the University of Cincinnati and West Virginia University.
3. MUSTANG (Penn Array Receiver) is a University Collaboration with the University of Pennsylvania.
4. The trajectory-generation and servo improvements are delayed because developing the new track model took longer than anticipated. Owing to necessary engineering work on other antennas, it was not possible to complete design work on the secondary-optics part of the PLC upgrade. That work has been deferred until this summer's painting and inspection period.
5. The Zspectrometer is a University Collaboration with Andy Harris at the University of Maryland.

OPERATIONS

2. NEW MEXICO OPERATIONS

NEW MEXICO OPERATIONS

New Mexico Operations management highlights for the quarter include:

- In January, New Mexico Operations management was alerted to a proposal made by UPC New Mexico Land Holdings LLC to the State of New Mexico to construct a high-voltage power line across the east and west arms of the VLA. A letter objecting to the proposed power-line route was submitted to the State Land Office Commissioner. NSF personnel were also notified, and contact was made with the main office of the power-line development corporation to arrange a meeting between NRAO's assistant director for New Mexico Operations and UPC's vice president for Western Business Development (this meeting took place in early April). With the assistance of AUI and senior NRAO management, NSF along with New Mexico's federal, state, and local legislative representatives have been contacted to help find an alternative to the proposed power-line route.
- A scientific staff retreat was held on February 7 in Socorro to consider the opportunities and challenges posed by the upcoming decadal survey. Mainly, but not exclusively, attended by NRAO New Mexico staff members, the meeting provided a forum to discuss what is currently known about the upcoming decadal process, and an opportunity to describe and discuss potential projects—both NRAO and community-wide—that might be suitable for proposing to the decadal survey committee. This meeting was followed up in April by an observatory-wide retreat, also held in Socorro.
- An AUI committee set up to examine NRAO operational models, chaired by Dr. Robert Milkey, had its inaugural meeting February 29–March 1 in Socorro.

VLA highlights for the quarter include:

- Fifteen EVLA antennas have now been retrofitted and restored to routine service; the sixteenth has nearly completed its mechanical overhaul.
- The February and March reconfigurations of the VLA to CnB and C configurations, respectively, were both completed slightly ahead of schedule.
- Renovation of the Visitor Center theater at the VLA site was completed about two weeks ahead of schedule.
- A one-day visit to DRAO by the EVLA Program Manager and the assistant director for New Mexico Operations was made in February to review management and progress on the WIDAR correlator.

VLBA highlights for the quarter include:

- The new replacement maser, ordered last year from Symmetricom Inc., was picked up and placed into service. The maser is working well.
- A special tiger-team visit was made to the Fort Davis VLBA site in order to replace a failing antenna elevation bearing.
- In order to verify procedures and software, test observations of NASA's Phoenix Lander as well as three other spacecraft orbiting Mars were successfully carried out during March. The VLBA is scheduled to track the Phoenix spacecraft's landing near Mars' north pole on May 25 as part of a New Initiatives Office demonstration project for NASA.

OPERATIONS

2. NEW MEXICO OPERATIONS

New Mexico Operations Management and Scientific Milestones

Milestones	Original Date	Revised Date	Date Completed
1. VLA/VLBA proposal deadline	02/01/08		02/01/08
2. Local scientific-staff retreat	02/07/08		02/07/08
3. Complete reconfiguration to CnB array	02/15/08		02/11/08
4. Return EVLA antenna 1 to array	02/05/08		02/22/08
5. Complete reconfiguration to C array	03/07/08		03/05/08
6. Proposal Scheduling Committee meeting	04/03/08		
7. Return EVLA antenna 5 to array	04/11/08		
8. VLBA tracks Phoenix landing on Mars	05/26/08		
9. VLA/VLBA proposal deadline	06/01/08		
10. Complete reconfiguration to DnC array	06/06/08		
11. 4-station board correlator delivered to VLA site	06/09/08		
12. Return EVLA antenna 2 to array	06/11/08		
13. Complete reconfiguration to C array	06/27/08		

Computer Infrastructure Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Establish network tunnel to DRAO	08/31/06	Dropping	
2. Establish network tunnel to ESO	09/30/06	Dropping	
3. Bring up EVLA antenna-4 network	01/24/08		01/15/08
4. Install initial 10 VLBA software-correlator nodes	unplanned		02/15/08
5. Retrofit existing antennas with new paging system	03/31/08		03/07/08
6. Bring up EVLA antenna-5 network			03/15/08
7. Design EVLA correlator network	01/31/08	04/30/08	
8. Bring up EVLA antenna-2 network	05/15/08		
9. Install 4-station correlator computers and network.	05/30/08		
10. Establish EVLA/AOC fiber plan	11/30/07	05/30/08	
11. Install EVLA correlator network	10/30/08		
12. Redhat EL5 (Linux) upgrade	10/30/08		

Notes:

1,2.Task transferred to Charlottesville.

7. Essentially done, need to fold in some new information.

10. In progress, working with Magdalena Ridge Observatory on letter of intent.

11. Labor is from present through October 2008.

12. Upgrades will progress from present through October.

OPERATIONS

2. NEW MEXICO OPERATIONS

Electronics Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Place into operation 12 additional Mark 5 disk packs	02/15/08		02/15/08
2. Repair the elevation bearing at FD-VLBA	04/04/08		03/28/08
3. Install a new IF cable wrap at SC-VLBA	04/15/08		
4. Build a VLBA software-correlator computer cluster using dual-quad processors installed in commercial standalone computers.	04/21/08		
5. Install the Mark 5 pressure enclosure at MK-VLBA	05/09/08		
6. Scheduled maintenance visit at NL-VLBA	05/30/08		
7. Scheduled maintenance visit at OV-VLBA	05/15/08	09/19/08	
8. Pickup new Maser #14 from Symmetricom, Inc.	06/05/08		03/12/08
9. Delivery of the prototype Mark 5C recorders	06/25/08		
10. Begin testing a Digital Back End (DBE) for the VLBA	03/15/08	06/23/08	
11. Design and install an EVLA-compatible API	07/30/08		
12. Complete a VLA prototype ACU system design	08/01/08		
13. Scheduled maintenance visit at SC-VLBA	11/20/08		
14. Perform development testing of the DBE1 and the Mark VB+ at six VLBA sites	11/21/08		

Notes:

10. Revisions to the Berkeley ROACH Computer card were delayed the board manufacturing. First-article hardware is now scheduled for June 2008.

Engineering Services Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Complete CnB array reconfiguration	02/15/08		02/11/08
2. Complete VLA Visitor Center theater remodel	03/15/08		02/28/08
3. Complete C array reconfiguration	03/07/08		03/05/08
4. Ft. Davis elevation-bearing replacement	03/21/08		03/06/08
5. Complete DnC array reconfiguration	06/06/08		
6. Complete D array reconfiguration	06/27/08		
7. Antenna 28 azimuth-bearing replacement	08/12/08		
8. Complete A array reconfiguration	10/03/08		
9. St. Croix Visit: Subreflector, paint, EL bearing, AZ wheel assy. replacement, general mech. maint.	10/30/08		
10. St. Croix antenna painting	12/15/07	10/30/08	
11. Replace 4,000 ties	11/30/08		

Notes:

7. St. Croix painting 99% complete; inside truss structure just below dish needs final topcoat. Painting will be completed during the Major Mechanical Maintenance Visit in the fall.

OPERATIONS

3. NA ALMA Science Center

NORTH AMERICAN ALMA SCIENCE CENTER (NAASC)

NAASC highlights for the quarter include:

- ALMA EPO program officer and NAASC commissioning scientist hired
- C. Brogan gave a plenary talk at the 211th AAS meeting in Austin TX on “Massive Star Birth and the Promise of ALMA.”
- The third NAASC Science Workshop “Transformational Science with ALMA: The Birth and Feedback of Massive Stars, Within and Beyond the Galaxy”, has been arranged for September 25–27, 2008 in Charlottesville.
- A beta release of the NAASC-supported “Database for Astronomical Spectroscopy: Splatalogue” occurred on February 1 (<http://www.splatalogue.net>).

Staffing remains a high priority for North American ALMA operations. An ALMA EPO program officer was recruited to start in the summer, and ALMA postdoc Anthony Remijan accepted a position on the scientific staff to serve as the NA ARC commissioning liaison to the JAO Commissioning and Science Verification (CSV) team. A second commissioning liaison is still being recruited.

The NAASC hosted the quarterly Science Operations IPT face-to-face meeting in Charlottesville in February. The main agenda item continues to be implementing the AOP, with discussions on CSV staffing requirements, software commissioning, helpdesk requirements, ARC archive implementation, and hiring needs. International search committees were set up to recruit the first cadre of JAO Operations Astronomers. This meeting marked the final gathering of the group that developed the ALMA Operations Plan, lead by outgoing JAO Director Massimo Tarenghi.

NAASC support and testing of ALMA offline software continued, coordinated by ALMA CASA Subsystem Scientist Crystal Brogan. The major activities during this quarter were: testing and preparing for the Beta patch 1 on March 30, setting development targets for the next quarter, and planning for CASA tutorials at the NRAO Synthesis Imaging Summer School in Socorro in June. A helpdesk and triage system has been established and ~10 helpdesk tickets were received by the end of the quarter. A CASA developer was recruited, but the offer was declined and the search will be re-initiated in the next fiscal year. Meanwhile, the Computing IPT hired ALMA postdoc Rob Reid in Charlottesville as a CASA developer to work with the NAASC staff.

The “beta” release of the NAASC-developed “Database for Astronomical Spectroscopy: Splatalogue” occurred on February 1 and is available at <http://www.splatalogue.net>. The main purposes of the release were to (1) illustrate the power of the search capabilities of the database over all available line catalogs; (2) introduce a new catalog to the community, the Spectral Line Atlas of Interstellar Molecules (SLAIM), which will only be available through Splatalogue, (3) provide the community with a complete list of frequencies of H, He, and C recombination lines, (4) add newly detected transitions to the Lovas list of detected astronomical transitions and (5) provide a limited sample of species (~200 out of 650) where the quantum numbers between all four catalogs were resolved, provide the line strengths and energy levels in useful astronomical units, and provide the community with an NRAO-recommended rest frequency for a molecular transition. Feedback on these goals has been sent to the ALMA Working Group on Spectral Line Frequencies, and updates and corrections are ongoing. Anthony Remijan leads this work.

NAASC staff continued to provide budgetary input to the NSF, including studies on the effects of currency conversion and commodities. Material was provided to the NRAO Visiting Committee and AUI

OPERATIONS

3. NA ALMA Science Center

Milkey committee and for the AUI co-operative agreement proposal. NAASC staff traveled to the STScI for a daylong “lessons learned” session on science user support and helpdesk implementation. NAASC staff participated in testing of the ALMA archive software system and provided detailed feedback on the ALMA archive operations plan.

NAASC staff is participating in the turno staffing at the ALMA Test Facility in Socorro. This activity involves prototype antenna and software testing and debugging, to gain familiarity with the system and train for eventual work in Chile and at the NAASC, and testing the functionality of CASA to import and analyze real ALMA data. Key achievements this quarter include producing the first interferometric spectrum and obtaining single-antenna spectra of the SiO maser line at 86 GHz to test spectral-line pointing of individual antennas.

The local organizing committee for the third NAASC workshop: “*Transformational Science with ALMA: The Birth and Feedback of Massive Stars Within and Beyond the Galaxy*” was convened. The meeting will be held in Charlottesville on September 25–27, 2008. A webpage was setup for pre-registration, a poster was produced and mailed, a newsletter article was published, and the first announcement was sent out.

The Canadian Memorandum of Understanding was sent to the HIA for final comment in February.

Finally, the NAASC staff was busy at the 211th AAS meeting in Austin, TX. C. Carilli participated in the NRAO Town Hall, A. Remijan gave a presentation on Splatologue, and C. Brogan gave a plenary talk on “Massive Star Birth and the Promise of ALMA” to a packed crowd.

NAASC Milestones January to March 2008

Milestones	Original Date	Revised Date	Date Completed
1. MOU on UVa joint positions, and first two hires	10/15/07		01/15/08
2. ANASAC interim charges—science input to development plan	01/15/08		01/15/08
3. Science center visits—Herschel	Fall 07	03/08	Canceled for now
4. Participate in ALMA archive test	12/07		01/16/08
5. Presentations at AAS: Invited review (Brogan) and NRAO Town Hall (Carilli)	01/10/08		01/10/08
6. New ALMA EPO hire	12/01/07	02/08	3/30/08
7. Two new hires for commissioning	12/30/07	02/08	1 st : 03/30/08 2 nd : pending
8. New MOU with Canada for ALMA operations	09/1/07	02/08	At HIA
9. Travel to STScI for “Lessons learned” on user support	02/19/08		02/19/08
10. SciOps IPT face-to-face meeting in Charlottesville	02/08		02/27/08
11. AUI NRAO operations review	03/08	ongoing	
12. NAASC Science Workshop III: pre-registration, poster, first announcement	03/08		03/24/08
13. Testing for CASA beta patch 1	03/20/08		03/30/08

OPERATIONS

3. NA ALMA Science Center

NAASC Milestones beyond April 2008

Milestones	Original Date	Revised Date	Date Completed
1. NRAO staff retreat	04/10/08		
2. Coordinate “Integrated NRAO Operations” vision with NM Ops, GBT Ops, E2E, DO, OSAA. Presentation to Milky committee.	05/01/08		
3. Users Committee meeting in Green Bank	05/20/08		
4. FY 2009 budget planning	05/08		
5. NAASC Science Workshop III: science program	05/22/08		
6. Set NAASC functional assignments for FY 2009	05/08		
7. SciOps IPT face-to-face meeting in Santiago	05/15/08		
8. Complete employee yearly evaluations	06/08		
9. Recruit NAASC Head	07/08		
10. Talks on ALMA science and status at NA institutions	ongoing		
11. Software testing: CASA, Pipeline, Simulator, Obstool	ongoing		
12. Offline software cookbook	ongoing		
13. Spectral-line catalogue—continue resolving species	ongoing		
14. Participation in SciOps IPT, ARC managers meeting	ongoing		
15. CASA tutorials	ongoing		

OPERATIONS

4. Central Development Lab

CENTRAL DEVELOPMENT LAB (CDL)

Central Development Lab highlights for the quarter include:

- At the request of the EVLA receiver engineers, the EVLA 12–18 GHz amplifier was redesigned with a waveguide instead of a K-connector input.
- A 75–110 GHz phase shifter scaled to 17–25 GHz was prototyped, fabricated, and measured.
- The K-band (18–26.5 GHz) focal plane array feed for the GBT was measured.
- Transitions for the EVLA Ku band (12–18 GHz) were designed.
- Room temperature on-chip measurements of the new NRAO-designed 35nm InP MMIC LNA made by NGST show the best noise temperature yet achieved at 67–95 GHz.

Amplifier Design and Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Develop prototype ALMA Band 1 and Band 2 amplifiers	06/30/07	09/30/08	
2. Redesign EVLA 12–18 GHz amplifier (waveguide instead of K-connector input)	06/30/08		

Notes:

1. The design of demonstration amplifiers for ALMA Band 1 (31–45 GHz) and Band 2 (67–90 GHz) receivers has been completed. Experimental evaluation awaits the availability of technician time.

Other Projects: Research on noise properties of heterostructure bipolar transistors (HBTs) and CMOS MOSFETs continues.

Amplifier Production Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Build/upgrade/repair cryogenic amplifiers using Cryo-3 TRW devices for the EVLA covering the frequency range from 1 to 50 GHz	12/31/15		ongoing activity
2. Build/upgrade/repair cryogenic amplifiers using Cryo-3 TRW devices for the VLBA and the GBT covering the frequency range from 1 to 95 GHz	ongoing		ongoing activity
3. Improvements to existing noise measurements systems	ongoing		ongoing activity

Notes:

1 and 2. New amplifier production included six 1–2 GHz low noise, two 1–2 GHz high dynamic range, two 4–8 GHz, four 18–26 GHz and four 26–40 GHz. Repair, upgrade, and retesting of amplifiers included two 1–2 GHz low noise, one 4–8 GHz, one 12–18 GHz, four 18–26 GHz, and two 26–40 GHz. In addition, one Cosmic Background Imager Ka-band amplifier was rebuilt and retested. In total, 29 amplifiers were shipped. EVLA production is on schedule.

OPERATIONS

4. Central Development Lab

MMIC Design and Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Develop differential LNA for balanced feeds	12/01/06	12/01/08	
2. Develop integrated wideband LNA–feed package	12/01/06	12/01/08	
3. Design and test GaAs W-band (75–110 GHz) power amplifiers to improve reliability of millimeter-wave local oscillators	03/01/07	12/01/08	
4. Evaluate InP HBTs for use in cryogenic amplifiers.	06/01/08		
5. Test 67–95 GHz 35nm InP MMIC LNA	10/31/07	05/31/08	
6. Develop cryogenic noise-calibration modules	03/31/08	09/30/08	

Notes:

1. Extensive effort has been put into designing this MMIC. Some progress has been made, but the combined specifications on input impedance, noise temperature, and dynamic range are proving to be the most challenging. A serious design will have to wait for the appropriate MMIC wafer run. Funding for experimental wafer runs such as these may become available through the newly founded Keck Institute for Space Studies at Caltech. We plan to pursue this development with them at a workshop in July.

2. See #1 above

3. Revised amplifier designs for ALMA Bands 3, 4, 7, 8, and 9 and new designs for Band 10 have been completed based on the latest nonlinear 70 nm process models available from BAE Systems. Fabrication began in February 2008 and is expected to complete in June 2008. RF testing at the foundry will take place in July, with delivery of approximately 1000 chips in August.

4. Several different sizes of InP HBTs from NGST have been measured at temperatures down to 12 K. We see a marginal (20%) increase in current gain (beta) when cooled accompanied by a small decrease in transconductance (g_m). These devices will work in cryogenic amplifiers; however, they will not give the large drop in noise temperature that HEMTs give when cooled. They may still prove useful in later stages of cryogenic amplifiers, where they can improve $1/f$ noise over all-HEMT amplifiers. The next step is obtaining a small-signal model of the device to integrate with a temperature-dependent noise model.

5. The 67–95 GHz MMIC LNA, using the new NGST 35nm InP HEMT process, was fabricated, and ten sample chips were delivered to the NRAO for testing. Room temperature on-chip measurements show 30 dB gain and 200–250 K noise temperature over the designed bandwidth. This is the best room-temperature noise measured at these frequencies. A module for cryogenic measurements has been designed and fabricated. Cold measurements will take place in May 2008.

6. Two commercial K-band (18–26 GHz) MMIC LNAs were packaged and tested as candidates for a stable cryogenic noise calibration source for the GBT K-band Focal Plane Array (KFPA). One of the MMIC LNAs was measured to have flat and stable noise output compared to a commercial warm noise diode. The power dissipation was also found to be acceptable for use in a cold receiver pixel. Design is underway for an integrated calibration source and coupler using this MMIC for the single-pixel KFPA prototype, which will be tested on the GBT in summer 2008.

OPERATIONS

4. Central Development Lab

Electromagnetic Support Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Develop dual-band 345/800 MHz feed for the GBT	09/30/05	06/30/08	
2. Measure EVLA 12–18 GHz feed	12/31/07	06/30/08	
3. Prototype, fabricate, and measure a 75–110 GHz phase shifter scaled to 17–25 GHz	03/31/07	03/31/08	03/31/08
4. Measure K-band (18–26.5 GHz) focal-plane-array feed	03/31/08		01/31/08
5. Design transitions for EVLA Ku-band (12–18 GHz)	03/31/08		03/31/08
6. Design and prototype EVLA X-band (8–12 GHz) OMT	09/30/08		
7. Design and prototype EVLA X-band phase shifter	09/30/08		
8. Measure and complete design of Ku-band polarizer	09/30/08		

Notes:

2. Delayed owing to unavailability of the antenna range.
3. The length of the phase shifter will be resolved by making measurement on a second prototype.

Other Projects:

Analyzed the effects of rotating and translating the ellipsoidal reflector on the ALMA Band 3 cartridge. Presented a talk on feeds and polarizers at the critical design review of the K-band focal-plane array in Green Bank in February.

Superconducting Millimeter-Wave Receiver Development Milestones

Milestones	Original Date	Revised Date	Date Completed
Balanced SIS Mixer Development			
1. Complete first balanced SIS mixer with superconducting IF hybrid	01/01/07	delayed	
2. Complete first balanced sideband-separating mixer	10/01/07	delayed	
Other Mixer Development			
3. 385–500 GHz SIS mixer Development	09/30/05	10/30/08	

Notes:

1 and 2. Delayed until the Arizona Radio Observatory (ARO) constructs a mixer test system. Balanced-mixer development is now continuing in the 385–500 GHz band—see 3.

1, 2, and 3. These projects are being done in conjunction with the ARO.

3. This project has been restarted with support from the ARO. Balanced SIS mixers are being designed at the CDL for fabrication at the University of Virginia Microfabrication Laboratory (UVML). UVML has now successfully fabricated Nb/Al-AIN/Nb SIS junctions as small as 0.6 μm (smaller than the 1.0 μm diameter required for the current 385–500 GHz SIS mixer). Further attention to the junction-defining liftoff process is required to improve the yield. UVML now has the components in hand to incorporate a Faraday plasma monitoring system in the AIN growth chamber. This will allow high critical current density AIN barriers to be made more reproducibly. Magnetron sputtered SiO_x is being studied as a replacement for the present evaporated SiO_x. This should give better edge coverage and fewer pinholes in the oxide layer.

OPERATIONS

4. Central Development Lab

Green Bank Solar Radio Burst Spectrometer (GB/SRBS) Milestones

Milestones	Original Date	Revised Date	Date Completed
GB/SRBS Phase III:			
1. 10–80 MHz, dual polarization, four crossed dipoles, new digital spectrometer	09/30/05	TBD	

Note:

1. The low-frequency antenna work has been delayed until summer 2008, pending funding.

The Precision Array to Probe the Epoch of Reionization (PAPER) Milestones

Milestones	Original Date	Revised Date	Date Completed
1. 16-element prototype array, operating in the 100–200 MHz band in Green Bank	12/31/06	06/15/08	
2. 32-element array in Western Australia	12/15/06	09/15/08	

Note:

1. Delay due to shop fabrication schedule and correlator delivery.

Electrochemistry Laboratory

The Chemistry Lab's gold-plating output at estimated commercial prices was over \$40,000. Small-scale jobs related to various development efforts are not estimated on a commercial basis, but they represent an ongoing savings in terms of materials, purchasing, shipping and receiving, and other transactional costs. An online tracking system for plating jobs was initiated in October 2007, and since its inception 100 "job numbers" have been assigned. The estimated average commercial value of these jobs is \$1500 per job.

A single bid was received for consulting and possibly providing a new electroforming system; it was rejected as beyond budget. After informally consulting with various vendors and industry sources, we decided to proceed with assembling our own electroforming system on a smaller scale than what had been previously used. This new system is currently being evaluated with encouraging results on the first small set of production pieces. We plan to resume copper electroforming with a current-generation process by the second quarter of 2008. During Q2 of 2008 we will assemble a second small electroforming system to allow for evaluation of copper plating chemistries with continued production in the first system.

OPERATIONS

5. Chile Operations

CHILE OPERATIONS

Chile Operations highlights for the quarter include:

- Arrival of the fourth Vertex antenna.
- Appointment of members of labor-related peer committees for health and safety.
- Various site-related contracts and calls for bid initiated or completed

Local Labor Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Implement Peer Safety Committees to comply with Chilean labor and health & safety regulations	03/08	08/05/08	
2. Implement the Right to Know Policy	03/08	08/05/08	

Business/Contracting Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Catering, cleaning and maintenance: contract approved by the NSF	12/13/07	04/30/08	
2. NRAO administration/business managers meeting Chile 2008	01/19 - 25/08		01/19 - 25/08
3. Implementation of formal business support to the JAO as a pooled effort	02/01/08		02/01/08

Notes:

1. Contract begins on May 1.

Other Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Environmental reporting to CONAMA	Monthly		Monthly
2. Environmental reporting to CONAMA	Biyearly		03/24/08
3. Annual payment of concession, Region II and CONICYT	1 st week of each year		01/04/08
4. Annual payment of mining rights.	03/08		03/31/08

Notes:

1. Monthly reports are sent to CONAMA;
2. Biyearly reports are sent to CONAMA.

OPERATIONS

5. Chile Operations

Chile EPO Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Local e-newsletter (developing design and contents)	03/08	04/08	
2. Organizing regular video courses between San Pedro de Atacama and Magdalena schools (in the framework of the Sister Cities Program)	03/08	05/08	
3. Organizing student exchange between San Pedro de Atacama and Magdalena schools (in the framework of the Sister Cities Program)	04/08	ongoing	
4. Planning activities in the framework of the Chilean node for IYA 2009	01/08	05/08	1Q 2009
5. Sending press releases to media	1Q 2008	ongoing	

OPERATIONS

6. END TO END Operations

END TO END (E2E) OPERATIONS

End to End Operations highlights for the quarter include:

- Proposal software with first features for proposal handling released in January 2008
- Co-development with Google on archive interfaces launched in February 2008
- Common Astronomy Software Applications (CASA) Beta Patch 1 completed in March 2008
- Service-oriented architecture for NRAO archive interfaces completed in March 2008

Archive and Pipeline Operations

Collaboration and support was greatly increased for ESO's NGAS storage technology this quarter. Several aesthetic and stability improvements were made to the archive interface front page at <http://archive.nrao.edu> as well. The Data Vault (Archive 2.0) beta was expanded to support a single search box for VLA, VLBA, and GBT data, and it was completely refitted to match the latest NRAO web template. Collaboration with Google started in February to investigate using Google Sky as a companion tool to the science data archive and to broaden access to NRAO science products. A new Data Vault framework was developed for ongoing integration of new services such as Google Sky, the Spectral Line Search Engine (SLiSE), and other useful add-ons in order to provide a fully featured archive user experience. This is a major advance that will facilitate rapid development.

Progress in VLA pipeline imaging continued in Q1 2008. The VLA Archive Survey now holds 72,839 images plus calibrated data files of 15,590 unique sky positions. These data represent most continuum observations made with the VLA between 1991 and 2003. Early 2008 saw the completion of the validation process on all images produced to this time. Much recent progress has been focused on improvements to the pipeline software in the areas of data processing and archiving. Once these are complete, imaging will continue on VLA continuum data and, subsequently, on spectral-line data.

Proposal Operations

The proposal submission tool (PST) successfully handled over 150 VLA and GBT proposals for the February 1, 2008 deadline. Additional validation rules and minor improvements to the GUI significantly reduced the number of user complaints compared to the last proposal submission. The capability to assign incoming proposals to review categories was also integrated.

Virtual Astronomical Observatory (VAO) Operations

NRAO participation in the NVO effort over the past quarter has emphasized ongoing IVOA standards development and related implementations, planning for the proposed operational phase of the U.S. VAO, and ongoing production and publication of VO-ready data from NRAO instruments including the VLA. In the area of standards development, most of the effort was focused on the Table Access Protocol (TAP) and a second version and major upgrade to the Simple Image Access Protocol (SIAV2), both efforts being led by D. Tody. Work continues on spectral access as well, including preparation a capability schema for SSA and registry support for legacy and standard Simple Spectral Access (SSA) services so that these can be described by the new registry. In the area of data-analysis standards, work is underway on interface specification for the applications framework project, which is a joint effort of NVO within the U.S. and OPTICON within Europe. Both N. Radziwill and D. Tody participated in planning for the Facility phase of NVO (now VAO), including planning for an expanded role and involvement for NRAO in the planned U.S. VO facility. J. Crossley, a post-graduate student who recently joined the NRAO VO effort, has

OPERATIONS

6. END TO END Operations

begun work on software for load testing VO services, as part of the planned facilities for service verification and testing.

Data Processing Development/CASA

CASA Beta Patch 1 was completed in March 2008. This included polarization calibration and imaging, basic image analysis (math, statistics, etc.), and model subtraction from (u,v) data. It also included many improvements for existing applications. The release included 64-bit distributions for Linux RHEL 4 and 5. Patch 2, expected in 1 June 2008, is addressed to the needs of the NRAO interferometry summer school. After Patch 2, the beta will be accessible to the public for testing.

The short-term goals for spring and summer 2008 are to make CASA more user-friendly, more reliable, and better documented for interactive use by observers. After this period, CASA must be available to support initial shared-risk science observations for the EVLA in Q4 2009. We are presently working with EVLA operations to establish an acceptable schedule for longer-term deliverables. For ALMA, CASA will be supporting commissioning needs: small-n baselines, ad-hoc processing, and single dish. Particularly important for both projects is importing the (very rich) raw-data format being adopted by both projects. It is critical to note that the telescope formats for the EVLA and ALMA are the same (with some telescope-specific fields/tables), thus enabling each telescope to much more easily leverage the software developed to support the other. Releases will be made quarterly. Each candidate release is exercised thoroughly by a group of testers, including astronomers from outside NRAO. The problems found are used to correct the present release and to provide development targets for subsequent releases.

Management & Administration Activities

Milestones	Original Date	Revised Date	Date Completed
1. Prepare for EVLA Science Support Systems review	03/31/08	deferred by EVLA	
2. Prepare for Visiting Committee review	03/31/08		03/31/08
3. Complete E2E strategic planning session	09/15/07	04/30/08	
4. Complete specifications for Strategic Decision Support System (a management dashboard)	09/30/07	07/15/08	
5. Prepare Partnership in Astronomy & Astrophysics Research and Education (PAARE) diversity proposal with NC A&T University	08/01/08		

Algorithm Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Create project charter for algorithm development	09/30/07	08/31/08	
2. Hold first NRAO Algorithm R&D Symposium	11/30/07	11/30/08	

OPERATIONS

6. END TO END Operations

NRAO Participation in the National Virtual Observatory (NVO) Project

Milestones	Original Date	Revised Date	Date Completed
1. Updated data-processing framework architecture	01/31/08		01/31/08
2. SSA V1.1 working draft	09/15/07	03/31/08	02/26/08
3. VAO Facility Proposal to NASA/NSF (Tody/Radziwill)	04/22/08		
4. TAP prototype with SimpleQuery functionality	11/05/07	04/30/08	
5. Draft applications messaging specification	10/25/07	04/30/08	
6. Attend IVOA interoperability workshop (Trieste)	05/12/08		
7. First draft applications framework interfaces doc	03/01/08	05/16/08	
8. DALServer updated for SSA standard (V1.02)	11/05/07	06/30/08	
9. VOClient with CLI, registry, SSA support	02/15/08	06/30/08	
10. Conduct sessions at 2008 NVO summer school	09/15/08		
11. Revised SIA V1.0 specification for PR	08/15/07	09/30/08	
12. Revised SIA V1.0 specification for PR	08/15/07	09/30/08	
13. Initial working draft and prototyping for SIA V2	09/15/07	09/30/08	

NRAO Archive Infrastructure & Interfaces

Milestones	Original Date	Revised Date	Date Completed
1. Publish NRAO KML files to Google Sky Gallery	03/31/08		03/31/08
2. Complete Data Vault (Archive v2.0) Beta, production release of Archive v2.0 (stable Google-like search query, results, and download of VLA, VLBA, and GBT data)	12/31/07	04/09/08	
3. Receive cost estimates from NCSA for long-term hosting and data curation	03/31/08	04/08/08	
4. Devise archive-index schema and replication scheme; resolve data integrity issues in current NRAO archive	04/30/07	05/16/08	
5. Update http://archive.cv.nrao.edu with new interfaces, begin summer beta test period	05/19/08		
6. Send invitation to scientists to contribute material for NRAO Showcase on Google Sky	05/19/08		
7. Install the Spectral Line Search Engine (SLiSE) to query the single-dish spectra database	12/31/07	06/15/08	
8. Document description and diagram of existing archive infrastructure	03/31/08	06/15/08	
9. Document database schema and diagrams (ERD) for the archive metadata/registry	06/31/07	06/15/08	
10. Develop pipeline to generate calibrated SDFITS data.	12/31/07	06/30/08	
11. Develop pipeline to generate preliminary calibrated, averaged dataset	12/31/07	06/30/08	

OPERATIONS

6. END TO END Operations

Milestones	Original Date	Revised Date	Date Completed
12. Release new archive interfaces to http://archive.nrao.edu	08/31/08		
13. Include 12 m and 140 ft data in the production single-dish archive node (requires capability to reduce data)	12/31/08		

NRAO Proposal Infrastructure & Interfaces

Milestones	Original Date	Revised Date	Date Completed
1. 08B Revisions available for user-acceptance testing	01/04/08		01/12/08
2. 08B PST Release	01/16/08		01/16/08
3. Integrate VLBA/HSA into PST	06/01/08		
4. Enable export of GBT source catalogs	06/01/08	09/30/08	
5. 08C Revisions available for user-acceptance testing	08/08/08		
6. 08C PST Release	08/16/08		

Data Processing (CASA/GBTIDL) Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Complete Beta Update 1.0 (bug fixes)	12/31/07		03/31/08
2. Complete memo detailing CASA efficiency and throughput (“Terabyte Initiative”) and summarize resulting recommendations	04/30/08	06/01/08	
3. Complete gap analysis to determine when CASA will be “done”	04/30/08	07/31/08	
4. Plan for first public release, including dates, complete	05/15/08	07/31/08	
5. Complete Beta Update 2.0 (bug fixes + functionality) for Synthesis Summer School	06/01/08		

NRAO Pipeline Infrastructure & Interfaces

Milestones	Original Date	Revised Date	Date Completed
1. Bind AIPS pipeline to live VLA observations	05/31/07	*	
2. Expand AIPS VLA pipeline to Level 2 processing	12/31/08		
3. Implement common search for VLA/Chandra	12/31/08		
4. Implement common search for NRAO/HST	12/31/08		
5. Implement common search for NRAO/Spitzer	12/31/08		
6. Second half of VLA archive processed via pipeline	06/30/08	06/30/09	

Notes: * – Deferred indefinitely until understanding of impact of EVLA on data quality fully understood.

OPERATIONS

7. Computer and Information Services

COMPUTER AND INFORMATION SERVICES (CIS)

CIS highlights for the quarter include:

- New VPN solution has dramatically improved remote-access performance and enabled clientless web-based access for key platforms.
- The updated www.nrao.edu was released at the end of February with widespread praise for the improved interface and content. This solution was leveraged by the Joomla! platform.
- NetApp storage increased by 2TBytes with low-cost upgrade to existing disk shelves
- Gold Book enhancement executed as planned with improved structure and user self-service.

Observatory-wide Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Upgrade link between UVa and NRAO-CV to 1 Gbps (d)	01/31/07	On Hold	
2. New VPN concentrator available (d)	09/30/07	02/29/08	03/01/08
3. "Gold Book" upgrade (c)	01/31/08		01/31/08
4. Annual system-administrator conference in CV (b)	04/30/08	05/14/08	
5. Re-bid Wide Area Network contract (d)	04/30/08	08/31/08	
6. Deploy Microsoft Office 2007 (b)	05/31/08	08/15/08	
7. Web content management overhaul (c)	05/31/08		02/25/08
8. Begin deployment of new Linux (RHEL5) (b)	05/31/08		
9. Data security plan roll-out to Tier 2 users	05/28/08		
10. Data security plan roll-out to all staff	06/11/08		
11. Survey NRAO for service prioritization for 5-year plan (b)	06/06/08		
12. Develop and deploy NRAO Paper bibliography service (c)	07/18/08		

Notes:

1. The contract has been formalized, but the installation was delayed by budget concerns.
5. Transition Manager request form has been submitted to GSA, but re-bid will entail two new circuits.
6. Deployment has been delayed 3 months by compatibility and user interface concerns.

- (a) Security
- (b) Common Computing Environments
- (c) World-wide web infrastructure
- (d) Telecommunications

Charlottesville Computing Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Install new computer-room power conditioning	02/29/08		02/23/08
2. Increased storage on the disk filer	03/31/08		03/07/08
3. Upgrade Exchange Server	03/31/08	07/31/08	
4. Integrate 20TByte library to back up all critical platforms	05/16/08		

Notes:

3. Exchange software was found to be incompatible with our virtualization solution. The system is being re-configured and the user account structure will be reorganized for improved manageability.

OPERATIONS

8. Education and Public Outreach

EDUCATION AND PUBLIC OUTREACH (EPO)

EPO highlights for the quarter include:

- NRAO electronic Newsletter “NRAO eNews” design completed.
- New NRAO website debut.
- *Cosmic Radio* program and podcast debut.
- Two ALMA high-definition video features completed.
- NRAO exhibition, Town Hall meeting, and Astro-Zone outreach event at the American Astronomical Society meeting in Austin, TX.
- NRAO exhibition and Family Science Fun Days outreach event at the American Association for the Advancement of Science meeting in Boston, MA.
- *Quiet Skies* proposal submitted to the IYA 2009 Program Committee.
- EPO proposal submitted as part of Virtual Astronomical Observatory (VAO) proposal to NSF.
- Eight press releases distributed.
- 4th annual AUI/NRAO Image Contest announced.

Publications / Documentation Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Publish January 2008 NRAO Newsletter	01/02/08		01/04/08
2. Call for April 2008 NRAO Newsletter submissions	03/01/08		03/01/08
3. Publish April 2008 NRAO Newsletter	04/01/08		
4. Complete NRAO eNews design	05/01/08		
5. Call for June 2008 NRAO eNews submissions	05/01/08		
6. Publish debut NRAO eNews	06/18/08		

Notes:

4. Sample NRAO eNews issues can be viewed at

<http://www.nrao.edu/news/newsletters/115/email1.html>

<http://www.nrao.edu/news/newsletters/115/email2.html>

Online Outreach Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Complete design and structure review with contractor (Renegade)	01/15/08		01/15/08
2. Beta site demo for Director’s Office	01/25/08		01/25/08
3. Beta site review and feedback complete	02/18/08		02/20/08
4. New science and EPO websites rollout	03/14/08		02/25/08
5. Implement web metrics	04/04/08		
6. Improve on-line video delivery options	05/23/08		
7. Implement VLBA and ALMA webcams	06/20/08		
8. Debut experts database for News Center	06/27/08		

OPERATIONS

8. Education and Public Outreach

Scientific Community Outreach Milestones

Milestones	Original Date	Revised Date	Date Completed
1. American Astronomical Society (Austin) exhibition	01/07– 11/08		01/07– 11/08
2. NRAO Town Hall (AAS, Austin)	01/10/08		01/10/08
3. American Association for the Advancement of Science (Boston)	02/14– 18/08		02/14– 18/08
4. Submit proposal to AAS for January 2009 NRAO Town Hall (Long Beach, CA meeting)	05/15/08		
5. American Astronomical Society / Astronomical Society of the Pacific exhibition (St. Louis)	05/31– 06/05/08		

Notes:

5. The NRAO is a co-sponsor of this meeting.

Education Program Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Astro-Zone (AAS outreach and education event; Austin)	01/06/08		01/06/08
2. Cosmic Radio program / podcast debut	01/08/08		01/08/08
3. Family Science Fun Days (AAAS outreach and education event; Boston)	02/16– 17/08		02/16– 17/08
4. Sponsor and judge Virginia Piedmont Regional Science Fair	03/06/08		03/06/08
5. Mail Research Experiences for Teachers (RET) offer letters	04/04/08		
6. Annual Community Open House (CV)	04/27/08		
7. Astronomy Day exhibition (Science Museum of Virginia)	05/10/08		
8. Dark Skies/Quiet Skies workshop (AAS/ASP/IYA 2009 education event; St Louis)	06/01/08		
9. Chautauqua Short Course (GB)	06/04– 06/08		
10. Contemporary Lab Experiences in Astronomy (GB)	06/12– 13/08		
11. Society of Amateur Radio Astronomers (GB)	06/28– 30/08		

EPO Community & Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. ALMA EPO Program Officer selection complete	09/28/07	04/08	
2. Submit Quiet Skies proposal to IYA 2009 Program Cmte	03/03/08		02/27/08
3. Albemarle County Public Schools kickoff meeting	03/05/08		03/05/08
4. Accept Albemarle County School Board commendation	03/13/08		03/13/08
5. Submit VAO EPO proposal to STScI	03/28/08		03/28/08

OPERATIONS

8. Education and Public Outreach

Milestones	Original Date	Revised Date	Date Completed
6. SKA Outreach kickoff telecon	04/02/08		
7. National Geographic filming at VLA (Known Universe)	04/14/08		
8. NRAO logo development review (Photoworks, round 1)	05/13/08		
9. NRAO logo development review (Photoworks, round 2)	06/23/08		

Notes:

- The Albemarle County School Board commended the NRAO for its support of the FIRST (For Inspiration and Recognition of Science and Technology) LEGO League and Tech Challenge.
- This was the first teleconference meeting of a reconstituted SKA outreach team that included participation from Australia, South Africa, North America (NRAO), and Europe.

Custom EPO Programs and Tours: GB Science Center and VLA Visitor Center

Milestones	Event Date
1. Sante Fe seniors (VLA Vis Ctr)	01/02/08
2. Fort Hill High School (GB Sci Ctr)	01/18–20/08
3. Virginia Department of Education (GB Sci Ctr)	01/22–24/08
4. Radford University (GB Sci Ctr)	01/25–26/08
5. UNM Physics and Astronomy (VLA Vis Ctr)	02/03/08
6. NM Seniors (VLA Vis Ctr)	02/08/08
7. Los Lunas Valencia High School (VLA Vis Ctr)	02/08/08
8. Western Albemarle High School (GB Sci Ctr)	02/08–09/08
9. NM Seniors (VLA Vis Ctr)	02/09/08
10. Boy Scout Troop 111 & 2215 (GB Sci Ctr)	02/15–16/08
11. Southeastern Cooperative Education Program (GB Sci Ctr)	02/16/08
12. Providence Day School (GB Sci Ctr)	02/21–23/08
13. Science Olympiad Students (VLA Vis Ctr)	02/22/08
14. Boy Scouts ABQ Troop 459 (VLA Vis Ctr)	02/23/08
15. West Stanly HS (GB Sci Ctr)	02/28–03/01/08
16. South Charleston High School (GB Sci Ctr)	03/05/08
17. Girl Scout Troop (GB Sci Ctr)	03/08/08
18. AICE Regional Conference (VLA Vis Ctr)	03/09/08
19. Georgia High School Academy (VLA Vis Ctr)	03/11/08
20. United World College (VLA Vis Ctr)	03/11/08
21. Linwood Holton Governor's School (GB Sci Ctr)	03/14–15/08
22. Lynchburg College (GB Sci Ctr)	03/20/08
23. Big Brother and Big Sisters of ABQ (VLA Vis Ctr)	03/22/08
24. Grosse Point North High School (GB Sci Ctr)	03/24–26/08

OPERATIONS

8. Education and Public Outreach

Milestones	Event Date
25. James Madison University (GB Sci Ctr)	03/28–29/08
26. University High School (GB Sci Ctr)	04/02/08
27. Old Dominion University (GB Sci Ctr)	04/04–05/08
28. VLA guided tours and Open House (VLA Vis Ctr)	04/05/08
29. GW Community School (GB Sci Ctr)	04/06–07/08
30. Zuni School (VLA Vis Ctr)	04/10/08
31. Glenville State College (GB Sci Ctr)	04/10–12/08
32. University of Texas – El Paso (VLA Vis Ctr)	04/12/08
33. Seneca Trail Christian School (GB Sci Ctr)	04/15/08
34. RV seniors, Colorado (VLA Vis Ctr)	04/18/08
35. Las Cruces Middle School (VLA Vis Ctr)	04/18/08
36. James River High School (GB Sci Ctr)	04/20/08
37. Wakefield School (GB Sci Ctr)	04/21–24/08
38. Quemado High School (VLA Vis Ctr)	04/22/08
39. University of Texas – El Paso Chem Eng (VLA Vis Ctr)	04/24/08
40. Rutgers University (GB Sci Ctr)	04/25–26/08
41. University of Texas – El Paso Physics & Astro (VLA Vis Ctr)	04/26/08
42. Estencia High Scholl gifted physics and astronomy (VLA Vis Ctr)	04/28/08
43. Washington and Lee University (GB Sci Ctr)	04/29/08
44. Cattle Industry group (VLA Vis Ctr)	05/06/08
45. Roswell MESA students (VLA Vis Ctr)	05/09/08
46. Reinhardt College (GB Sci Ctr)	05/10–17/08
47. Sarracino Middle School (VLA Vis Ctr)	05/12/08
48. Bernalillo High School gifted science (VLA Vis Ctr)	05/13/08
49. Cross Lanes Christian School (GB Sci Ctr)	05/15/08
50. Holden Elementary School (GB Sci Ctr)	05/28/08
51. Newburgh Free Academy (GB Sci Ctr)	05/29–31/08
52. Rivesville Elementary/Middle School (GB Sci Ctr)	06/02/08
53. REU/RET training (VLA Vis Ctr)	06/14/08
54. Boy Scout camp leaders (VLA Vis Ctr)	06/19/08
55. Glenville State College Summer Camp (GB Sci Ctr)	06/21–23/08

MANAGEMENT

1. Administration

MANAGEMENT

ADMINISTRATION

Environment, Safety, and Security (ES&S)

ES&S work this quarter focused implementing card access in Green Bank. The rollout of the program has been deferred by the administrative efforts necessary to manufacture and distribute the cards. This quarter, the effort will focus on ensuring that the Charlottesville and Green Bank systems are compatible.

Milestones	Original Date	Revised Date	Date Completed
Present Security Audit findings	01/15/08	Complete	01/15/08
Complete NRAO Safety Manual updates	03/30/08	Complete	02/15/08
Implement card-access controls for Green Bank	12/01/07	06/01/08	
Prepare plans for NRAO Emergency Preparedness efforts (evacuation drill pending at the NTC)	12/01/07	01/31/08	02/15/08
Supplement ES&S staff in Socorro	01/01/08	01/07/08	01/07/08
Business-continuity planning, pending Peoplesoft completion	FY 2007	Pending	

MANAGEMENT

2. Human Resources

HUMAN RESOURCES (HR)

Diversity Program Activities for this quarter included:

Female (F) and Minority (M) staffing

- Senior compensation Analyst (F)
- Telescope Mechanic (H)
- Software Engineers (1F/1H)
- Associate Astronomer (B)
- Human Resources Assistant (F)

Black Engineer of the Year Conference, February: The Observatory sponsored an exhibit/recruitment booth for the second year. The conference is held annually in Baltimore, Maryland. The NRAO representatives were A. Shelton, Division Head of Green Bank Software Development, Eugene Cole, EVLA Project Scheduler–Socorro, and Roy Norville, Employment Manager. Resumes of interested persons were received from 15 full-time job seekers and 19 possible interns or co-op candidates.



Amy Shelton and Eugene Cole at the Black Engineer of the Year Conference, February 2008.

National Society of Black Engineering Conference, March – The Observatory provided an exhibit/recruitment booth for the third year. The NRAO representatives were J. Banda, Electronics Engineer–NTC, Sivasankaran Srikanth, Sr. Research Engineer–NTC and Roy Norville, Employment Manager. From this conference the Observatory generated twenty-one resumes of full-time and internship candidates.

MANAGEMENT

2. Human Resources



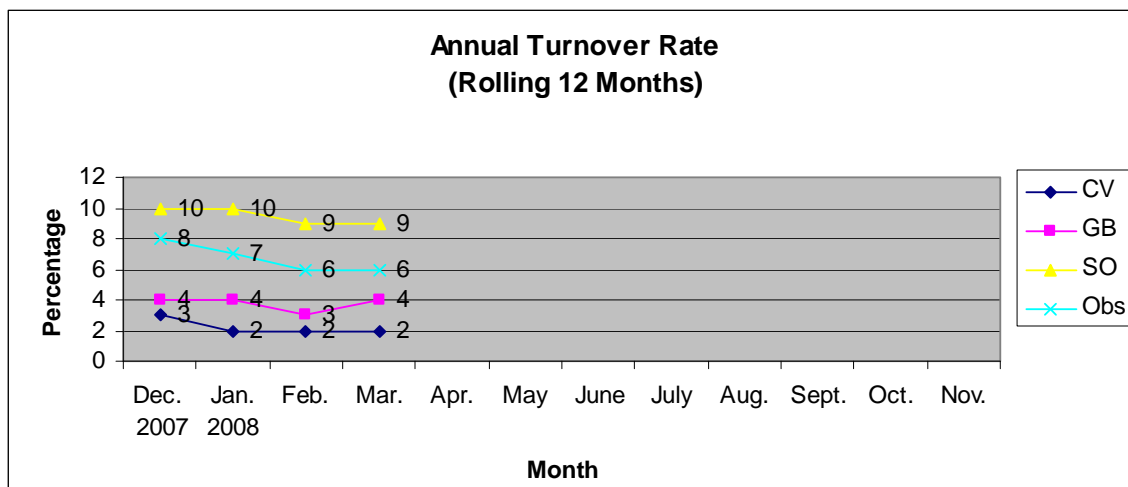
S. Srikanth and J. Banda at the National Society of Black Engineering Conference, March 2008.

Owing to the Observatory's low turnover and reduced engineering recruitment demand at this time, the Observatory's presence at the conference was primarily to advertise the NRAO to the technical community as well as gather contacts for personnel recruitment in the future.

Performance Evaluation Program

The Observatory has embarked upon a redesign of the PEP system within the Observatory. Major changes to the design include a new scientific staff evaluation form and procedure and redirection toward a performance based/merit driven evaluation for all regular full-time employees.

Employee Turnover Performance



The Observatory continues downward trend for employee separations.

MANAGEMENT

2. Human Resources

Affirmative-action Plans and Diversity within the Observatory

The NRAO, with the assistance of a highly respected affirmative-action consultant, Ms. Cornelia Gamlem, SPHR, of the GEMS Group, Ltd., presented the current affirmative-action plan to senior management staff and the managers at all three major observatory sites. The presentation highlighted the current diversity of women and minorities within the various job groups of the Observatory as well as highlighting the need for continued recruitment and promotion of women in the senior scientific and professional ranks of the NRAO. This presentation will be repeated annually.

The Human Resources Division is currently reviewing vendor proposals for an online recruitment module that will provide the Observatory with a secure and completely DOL-compliant system for the accumulation, review, selection, and reporting of qualified applicants for employment. The “Internet Applicant” standard recently developed by the DOL requires a higher level of quantifying “qualified” applicants than the HR division can now provide. We hope that a new module will be funded by the end of the 3rd quarter.

Personnel

NEW HIRES

Evans, Aaron	Associate Astronomer	01/01/08
Guerra, Miguel	Software Engineer II	01/02/08
Halstead, David	Assistant Director, CIS	01/03/08
Thompson, Charles	Safety Officer	01/07/08

TERMINATIONS

McCarty, Rebecca (Warner)	Supervisor, Housekeeping and Food Services	03/31/08
Ridgeway, Robert	Electronics Engineer II	01/25/08
Lucero, Sarah	Software Engineer II	01/25/08

REHIRE

Brandt, Patrick	Software Engineer III	02/25/08
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PROMOTIONS

Broilo, Robert	Electronics Engineer I	03/01/08
Morris, Keith	Electronics Engineer II	03/01/08
Alderman, David	Electronics Engineer II	03/01/08

TRANSFERS

Sramek, Richard	Test Scientist (SO to CH)	03/13/08
Whiteis, Peter	Software Engineer I (SO to GB)	01/01/08
Duvall, Eugene	Electronics Engineer II (SO to CH)	01/01/08

BUDGET

The NRAO is operating under a continuing resolution as of the end of the second quarter. The pre-continuing resolution President's Request Level (PRL) budget is \$52,740k. With the continuing resolution in place, the NRAO is currently funded at its FY 2007 level of \$50,740k, or \$2,000k less than the PRL budget. At the beginning of the fiscal year, the NRAO Operations budget included \$7,644k for ALMA Operations and \$6,010k for the EVLA. Early in the first quarter, ALMA Operations was established as a separate Scientific Program Order (SPO) under the AUI Cooperative Agreement. The NRAO Operations budget was reduced by \$7,644k from \$50,740k to \$43,096k, still including the EVLA. Excluding the EVLA results in a net NRAO Operations budget of \$39,086k.

When combined with prior-year commitments and prior-year carryover, the NRAO Operations total budget, less EVLA, is \$47,075k. As of March 31, new funding in the amount of \$32,322k was received for NRAO Operations and \$3,822k was received for ALMA Operations. Overall, the NRAO Operations budget is approximately 6.6% (annualized) below a linear spending rate through the first quarter. The following is a brief explanation of those WBS level 1 elements that are under/over spent in excess of 10% based on a linear projection rate.

- **Observatory Management.** Materials and Services expense continues to significantly lag a linear spend rate due to the need to retain reserve as an offset to the expected fiscal year 2009 and 2010 funding shortfalls.
- **Central Development Lab.** Materials and Services expense lag behind a linear spend rate. Funds in the amount of \$70k have been set aside for a CDL facility renovation scheduled to occur later this fiscal year. Once the renovation funds are expended, the CDL budget will be in line with a linear spend projection.

MANAGEMENT

3. Budget

NRAO Operations Expenses and Commitments FY 2008 Year to Date (October 1, 2007 to March 31, 2008) in \$000							Percent of fiscal year	50.0%
WBS Level I	Salaries & Benefits	Materials & Services	Travel	Revenue or Cost Recovery	Total	Linear Spending	Actual Exp + Comm	Actual Percent Expended & Committed
Observatory Management	6,111	2,668	344	-150	8,973	4,486	3,118	34.7%
Education and Public Outreach	582	244	21	-125	722	361	388	53.7%
Central Development Lab	1,491	216	23		1,730	865	726	41.9%
Green Bank Operations	8,901	2,766	145	-463	11,349	5,674	5,349	47.1%
New Mexico Operations	14,489	4,232	157	-80	18,798	9,399	9,661	51.4%
Computer and Information Services	1,066	737	25		1,829	914	924	50.5%
Science and Academic Affairs	1,827	1,461	386		3,674	1,837	1,826	49.7%
NRAO Operations total	34,467	12,325	1,101	-818	47,075	23,537	21,992	46.7%

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
AAS	American Astronomical Society
ACU	Antenna Control Unit
AIPS	Astronomical Image Processing System
AlN	Aluminum Nitride
ALMA	Atacama Large Millimeter Array
ANASAC	ALMA North American Scientific Advisory Committee
AOC	Array Operations Center (Socorro, NM)
AOP	ALMA Operations Plan
AOS	Array Operations Site (ALMA)
API	Atmospheric Phase Interferometer
ARC	ALMA Regional Center
ARO	Arizona Radio Observatory
ASAC	ALMA Scientific Advisory Committee
AUI	Associated Universities, Incorporated
BDF	Binary Data Format
BAE	British Aerospace Engineering
C band	4–8 GHz
CASA	Common Astronomy Software Applications
CASPER	Center for Astronomy Signal Processing and Electronics Research
CD	Compact Disk
CDL	Central Development Laboratory (Charlottesville, VA)
CICADA	Configurable Instrument Collaboration for Agile Data Acquisition
CIO	Chief Information Officer
CIS	Computer and Information Services
CLI	Command-Line Interface
CMOS	Complementary Metal-Oxide Semiconductor
Co-I	Co-Investigator
CONAMA	Chilean National Environmental Commission
CONICYT	Comisión Nacional de Investigación Científica y Tecnológica (Chilean NSF)
CSV	Commissioning and Science Verification (ALMA)
CV	Charlottesville
DAL	Data Access Layer
DBE	Digital Back End
DDS	Direct Digital Synthesizer
DO	Director's Office
DOL	Department of Labor
DRAO	Dominion Radio Astrophysical Observatory
DSS	Dynamic Scheduling System (GBT)
DTS	Digital Transmission System
E2E	End-to-End
EPO	Education and Public Outreach
ERD	Entity Relationship Diagram
ES&S	Environment, Safety, and Security (NRAO)
ESO	European Southern Observatory
EVLA	Expanded Very Large Array
FASR	Frequency-Agile Solar Radiotelescope

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
FD	Fort Davis VLBA station
FPGA	Field-Programmable Gate Array
FY	Fiscal Year
GaAs	Gallium Arsenide
GB	Green Bank
GB/SRBS	Green Bank Solar Radio Burst Spectrometer
Gbps	Giga bits per second
GBT	Green Bank Telescope
GBTIDL	GBT Interactive Data Language
GHz	Gigahertz
GLAST	Gamma-ray Large-Area Space Telescope
GSA	General Services Administration
Gsps	Giga samples per second
GUI	Graphical User Interface
GUPPI	Green Bank Ultimate Pulsar-Processing Instrument
HBT	Heterostructure Bipolar Transistor
HEMT	High-Electron-Mobility Transistor
HSA	High-Sensitivity Array
HIA	Herzberg Institute of Astrophysics
HR	Human Resources
HST	Hubble Space Telescope
IF	Intermediate Frequency
InP	Indium Phosphide
IPT	Integrated Product Team
ISSTT	International Symposium on Space Terahertz Technology
IT	Information Technology
IYA	International Year of Astronomy (2009)
IVOA	International Virtual Observatory Alliance
JAO	Joint ALMA Observatory
JPL	Jet Propulsion Laboratory
k	thousand
K	Kelvins (temperature)
K band	18–26.5 GHz
Ka band	26.5–40 GHz
KFPA	K-band Focal-Plane Array receiver (GBT)
KML	Keyhole Markup Language
Ku band	12–18 GHz
L band	1–2 GHz
LNA	Low-Noise Amplifier
LO	Local Oscillator
M&C	Monitor and Control
MHz	Megahertz
MIB	Module Interface Board
MK	Mauna Kea (VLBA station)
mm	millimeter
MMIC	Monolithic Microwave Integrated Circuit

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
MoO	Mission of Opportunity (NASA)
MOSFET	Metal-Oxide Semiconductor Field-Effect Transistor
MOU	Memorandum of Understanding
MPIfR	Max Planck Institut für Radioastronomie
MSI	MidSized Infrastructure (NSF program)
µm	micrometer
MUSTANG	Multiplexed Squid TES Array at Ninety GHz (GBT “Penn Array” receiver)
NA	North American
NAASC	North American ALMA Science Center
NASA	National Aeronautics and Space Administration
Nb	Niobium
NCSA	National Center for Supercomputing Applications
NGAS	Next Generation Archive Systems
NGST	Northrop Grumman Space Technology
NIST	National Institute of Standards and Technology
NJIT	New Jersey Institute of Technology
NL	North Liberty (VLBA station)
nm	nanometer
NRAO	National Radio Astronomy Observatory
NSF	National Science Foundation
NTC	NRAO Technology Center (Charlottesville)
NVO	National Virtual Observatory (now VAO)
OMT	Orthomode Transducer
OOF	Out Of Focus (holography)
OPT	Observation Preparation Tool
OPTICON	Optical–Infrared Coordination Network for Astronomy
OSAA	Office of Science and Academic Affairs (NRAO)
OSF	Operations Support Facility (ALMA)
OV	Owens Valley (VLBA station)
PAPER	Precision Array to Probe the Epoch of Reionization
PDR	Preliminary Design Review
PI	Principal Investigator
PLC	Programmable Logic Controller
PR	Proposed Recommendation
PRL	President’s Request Level
PST	Proposal Submission Tool
PTC	ProtoType Correlator (EVLA)
PTCS	Precision Telescope Control System (GBT)
Q	Quarter
Q band	40–50 GHz
R&D	Research and Development
RET	Research Experiences for Teaches (NSF program)
REU	Research Experiences for Undergraduates (NSF program)
RF	Radio Frequency
RFI	Radio-Frequency Interference
ROACH	Reconfigurable Open Architecture Computing Hardware

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
RSS	Really Simple Syndication
RTP	Round-Trip Phase
S band	2–4 GHz
SC	Saint Croix (VLBA station)
Sci Ctr	Science Center (Green Bank)
SDFITS	Single-Dish Flexible Image-Transport System
SDM	Science Data Model
SIA	Simple Image Access
SIS	Superconductor–Insulator–Superconductor
SKA	Square Kilometre Array
SLAIM	Spectral Line Atlas of Interstellar Molecules
SLISE	Spectral Line Search Engine
SOS	Student Observing Support (NRAO program)
SPHR	Senior Professional in Human Resources
SPO	Scientific Program Order
SRBS	Solar Radio-Burst Spectrometer (Green Bank)
SSA	Simple Spectral Access
SSS	Science Support Systems
STScI	Space Telescope Science Institute
TAP	Table Access Protocol
TBD	To Be Determined
TByte	TeraByte
TDP	Technology Development Program (SKA)
Telbib	Telescope bibliography
THINGS	The HI Nearby Galaxies Survey
TRW	TRW Corporation
U band	12–18 GHz
URSI	International Union of Radio Science
(u, v) data	Interferometer visibility data
UVa	University of Virginia
UVML	University of Virginia Microfabrication Laboratory
VAO	Virtual Astronomical Observatory
Vis Ctr	Visitor Center (VLA)
VLA	Very Large Array
VLBA	Very Long Baseline Array
VLBI	Very Long Baseline Interferometry
VO	Virtual Observatory
VPN	Virtual Private Network
VSOP-2	VLBI Space Observatory Program successor
W band	68–117 GHz
WBS	Work Breakdown Structure
WIDAR	Wideband Digital Interferometric Architecture (EVLA correlator)
X band	8–12 GHz