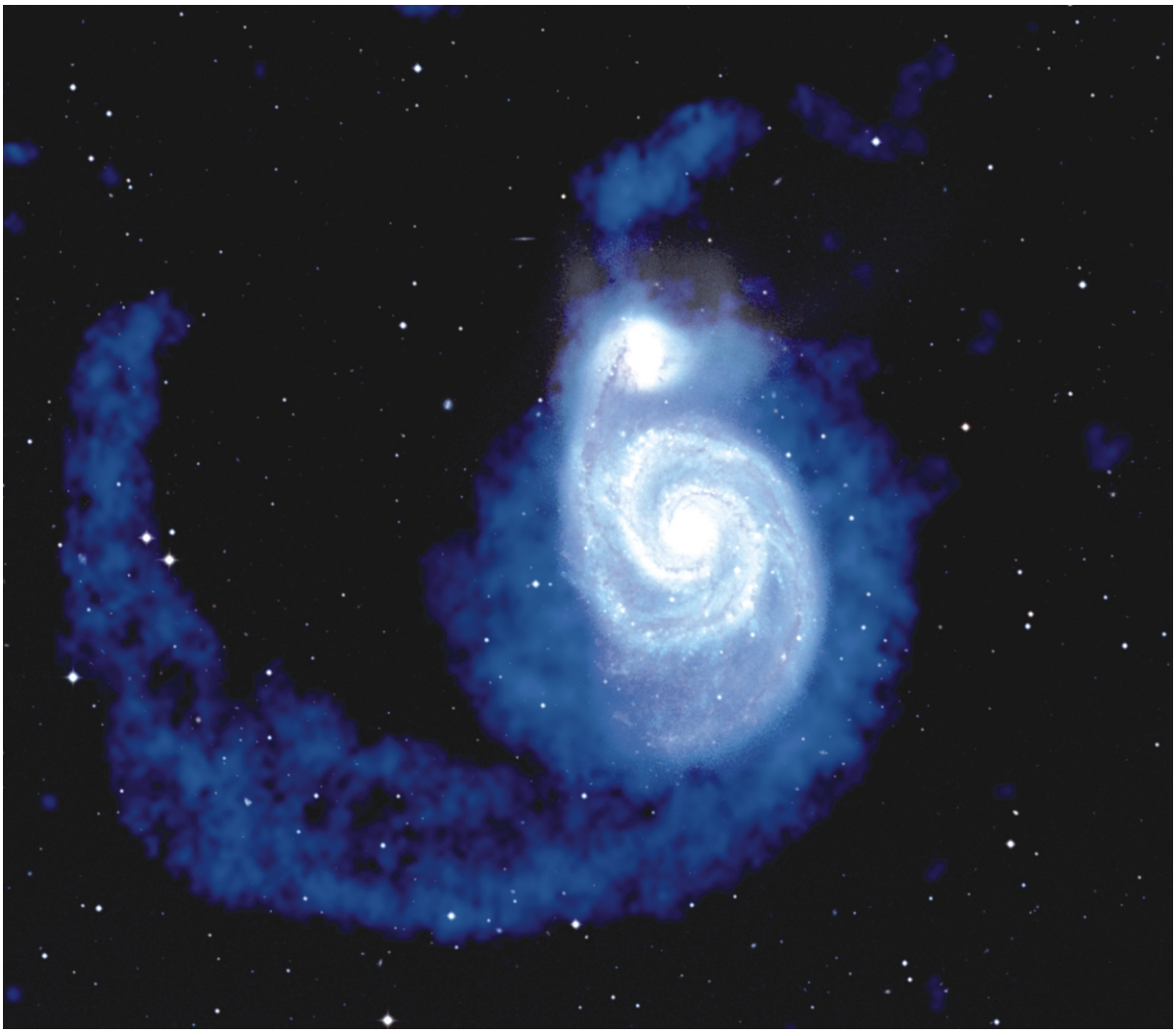
National Radio Astronomy Observatory



Quarterly Report

October – December 2006

NATIONAL RADIO ASTRONOMY OBSERVATORY

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Cover Image: The long tidal tail of Hydrogen gas shown in this image was shaken loose by the dance of M51, the Whirlpool galaxy, with its companion NGC 5195. Investigators: A.H. Rots, J.M. van der Hulst, P.E. Seiden, R.C. Kennicutt, P.C. Crane, A. Bosma, L. Athanassoula, & D.M. Elmegreen. Image composition by Juan Uson.

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EXECUTIVE SUMMARY

Science and Academic Affairs

During the fourth quarter of 2006, the Scientific and Academic Affairs (SAA) division hosted the internal meeting "Future Directions for NRAO in cm/m Astronomy" and helped to organize the "Chicago II" meeting in Tucson to discuss U.S. scientific priorities. The NRAO large-proposal policy was extensively revised and a funding policy to support large proposals was developed. The very successful GBT student support program was expanded to cover all NRAO telescopes.

The assignment of scientific staff to functional support areas was completed. Two Jansky appointments ended, and two new appointments (Dan Marrone and Wei-Hao Wang) began. Two scientists in Charlottesville (Barry Turner and Qi Feng Yin) retired.

The SAA division is presently developing a staffing plan that analyzes staff demographics, functional and research roles of the staff, and optimal staffing levels.

The 2006 NRAO summer-student research assistantships program ended with 23 students completing their appointments: six at Green Bank, seven at Charlottesville, and ten at Socorro. Travel grants were provided that allowed twelve students to present results from their summer projects at the January 2007 AAS Meeting in Seattle, Washington.

New Initiatives

Work continued on definition of the Square Kilometer Array (SKA) revised work plan for the Technology Development Project of the U.S. SKA Consortium. The NRAO also participated in the planning process for the European Seventh Framework Programme proposal for infrastructure and technology development for the SKA. The NRAO began planning for possible involvement in the VSOP-2 Space VLBI mission by participating in the kickoff meeting for developing the VSOP-2 tracking stations. Negotiations are under way to develop a variety of VLBA partnerships, in response to the National Science Foundation Senior Review report. Work to refine the operational, management, and governance models for the Frequency Agile Solar Radio Telescope (FASR) proceeded under NRAO leadership.

Green Bank Operations

The fourth quarter of 2006 saw work on five instruments—the C-band (4–6 GHz) receiver (with its upgrade partially completed), the Q-band (40–49 GHz) receiver, the Ka-band (26-–40 GHz) receiver, the Penn Array, and the Zpectrometer. Commissioning tests for the C- and Q-band receivers were successful, with the partially refurbished C-band receiver's system temperature having decreased to 15–20 K from 22–30 K. Both receivers have been released for general use. The second phase for work on the C-band receiver is still planned for summer 2007. Results from the Ka-band receiver indicate that its performance is still unacceptable for both cross-correlation and wideband spectral-line work, and further work on that receiver is being planned. Overall the performance of the Zpectrometer was good, but improvements in the Ka-band receiver are needed for the system to reach its full potential as a correlation spectrometer. The first round of commissioning for the Penn Array receiver was also completed during this quarter, and the results from those tests are currently being documented.

All plans and schedules for the GBT track work were completed in this quarter, and the construction of the new base and wear plates has begun.

During this quarter considerable effort was also spent constructing the plans for true dynamic scheduling on the GBT. A project charter for the dynamic scheduling project will be completed during the first quarter of 2007, and an external review of the project is planned for the second quarter of the year.

Work on improving the performance of the telescope at high frequencies (the PTCS project) also continued through this quarter. Work has begun on upgrades to the GBT servo system to add friction compensation and acceleration feed-forward; these will improve the performance of the antenna when "nodding" between beams (e.g. for Ka- and Q-band observing) and when performing complex scan patterns such as daisy-petal scans. We also continue to work on an improved pointing model which will incorporate inclinometer data directly; this model will be used when we re-commission the antenna after the track remediation.

Expanded Very Large Array (EVLA)

As of December 31, 2006 a total of nine antennas were in various stages of retrofit to the EVLA design. Six of these antennas are used routinely for astronomical observations, one antenna is undergoing tests, the electronics outfitting of another antenna is nearing completion, and the mechanical outfitting of the ninth antenna is underway. A critical design review of the EVLA Monitor and Control Transition System was held on December 5–6, 2006, and a workshop was held on December 12 to identify project risks. A longstanding problem that causes sudden jumps in visibility phase has now been traced to a central reference generator in the local oscillator. Tests of the prototype 3-bit, 4Gsps sampler show that its performance meets project specifications. The 1–2 GHz wideband orthomode transducer (OMT) was installed on an antenna for on-the-sky tests, and laboratory tests of a 4–8 GHz version of the OMT are promising. Testing of the WIDAR correlator baseline boards is under way. Significant progress was made towards the goal of retiring the Modcomp-based VLA control system, and the new EVLA monitor and control system was used to control the VLA correlator in astronomical observations. The design of the software for the Observation Scheduling Tool was completed, and a graphical user interface was developed to manage astronomical source catalogs.

Very Large Array

The annual frozen release of the AIPS (Astronomical Image Processing System) post-processing software for VLA and VLBA, as well as the rollover to the new daily-updated 31DEC07 version, were carried out on schedule. The new VLA correlator controller, critical for transitioning from array control by the old monitor/control hardware, was completed. A new plan for controlling radio frequency interference at the VLA site was developed, appropriate for the more sensitive observing and electronic systems of the EVLA.

Very Long Baseline Array

The NRAO initiated a strong technical collaboration with MIT-Haystack Observatory for future development of a much higher sensitivity VLBA. Specific areas of collaboration include wide-bandwidth digital back-end systems to replace the VLBA baseband converters and samplers, as well as "real time" eVLBI. Another program was initiated, in collaboration with the Max Planck Institut fuer

Radioastronomie and the NRAO Central Development Laboratory, to replace the old VLBA 22 GHz amplifiers and improve the VLBA 22 GHz sensitivity by approximately 25%.

North American ALMA Science Center (NAASC)

The NAASC proposal was submitted to the NSF on October 31, 2006, and the global ALMA Operations Plan (AOP) was submitted to the ALMA Board on November 3, 2006. These represent major milestones for operations planning. An internal NRAO+Canadian review was held of the NAASC plan in mid-October, following an external review by the ANASAC in the previous quarter. The plan was also reviewed by AUI and the NRAO director's office prior to submission.

John Hibbard and the Joint ALMA Office (JAO) presented the AOP to the ALMA Board in Madrid in November. ALMA Regional Center (ARC) managers and members of the operations working group (including Chris Carilli, the JAO directors, and the new Head of Science Operations) met face-to-face in Madrid in November to discuss the AOP, and John Hibbard visited Chile in December to work on details of the AOP with the JAO. Initial comments on the AOP from an ALMA Board sub-committee were transmitted to John Hibbard, and these were incorporated.

Two ALMA North American Scientific Advisory Committee (ANASAC) telecons were held this quarter. Issues discussed included project news, reports from the Madrid science meeting, an ALMA Scientific Advisory Committee (ASAC) update, an update on the NAASC/AOP proposals, a discussion of time allocation issues, and a discussion of future workshops. NAASC monthly organizational meetings continued with Canadian participation. Numerous telecons were held by the operations working group, led by John Hibbard. ALMA operations slides were presented at the AUI Executive Committee Meeting.

A pan-ALMA science meeting was held, with great success, in Madrid in November. Presentations were made by members of the NAASC. Planning for the next NAASC workshop "Transformational Science with ALMA: Through Disks to Stars and Planets" is proceeding; this workshop is scheduled for June 2007. There are already over 100 pre-registrants. An article was submitted for the January NRAO Newsletter. A series of lectures about ALMA at universities is being planned for spring 2007.

Major milestones for the next quarter include the submission of the final AOP for external review plus the international and national panel reviews of both the AOP and the NAASC plan at NSF Headquarters at the end of February. Chris Carilli, the NSF review panel, and members of the NSF and JAO will visit the ALMA site in January 2007. February and March will see major testing of the CASA (Common Astronomy Software Applications) off-line software by members of the NAASC and testing of the ALMA pipeline by members of the NAASC.

Central Development Laboratory (CDL)

Activities at the Central Development Laboratory this quarter included:

Device and Component Research, Development, and Production:

- Research continues on the noise properties of Heterostructure Bipolar Transistors (HBTs). This effort may lead to the development of low-noise amplifier chains with much smaller $1/f$ gain fluctuations than those currently available and result in much-improved broadband radiometers.
- The designs of 18–26 GHz and 26–40 GHz low-noise amplifiers for the new EVLA receivers have been completed. A total of 21 amplifiers were built or upgraded for the EVLA and GBT.

- Fabrication of MMIC (Monolithic Microwave Integrated Circuit) Voltage Controlled Oscillators (VCOs) has been completed. A MMIC VCO with 14.5–18.2 GHz on-wafer tuning bandwidth has been measured.
- The effort to develop advanced NbTiN/insulator/Nb tunnel junctions for frequencies above 700 GHz continues at the University of Virginia Microfabrication Laboratory. The first mixer block, for a 211–275 GHz balanced SIS mixer with a superconducting IF hybrid, has been fabricated at the University of Arizona and delivered.
- A prototype W-band (84–106 GHz) phase shifter scaled to K-band (18–26 GHz) has been fabricated and measured. The discrepancy between the measured and the design differential phase shift will be investigated.

Instrument Development:

- A major upgrade to the Green Bank Solar Radio Burst Spectrometer has been completed and commissioning is underway.
- The Reference Instrument concept for the Frequency Agile Solar Radiotelescope (FASR) is currently under development.
- Work continues on the Precision Array to Probe the Epoch of Reionization (PAPER) to measure the predicted step in the cosmic background amplitude from neutral hydrogen at the Epoch of Reionization. An eight-element array at the Green Bank, Galford Meadow site continues to provide data for the development of wide-field imaging techniques. Initial deployment in Western Australia has been rescheduled for July 2007.

Chile

Chile operations milestones completed include hiring NRAO Chile business staff and implementing ALMA Local Staff regulations, enlarging the ALMA Contractors Camp, starting collaboration on Vertex Antenna site Erection Facility, completing electrical/mechanical purchases for AOS TB, and enlarging the water-treatment plant. Monthly environmental reporting to CONAMA, the Chilean National Environmental Commission were done. Internal and external audits of the Chile office were completed.

End to End (e2e) Operations

The key accomplishments in fourth quarter 2006 were: (a) the refinement of the VLA automated data-processing pipeline to all configurations and most frequencies, improving its scientific integrity, (b) continued generation of almost 30 more gigabytes of VLA images and supporting calibrated data, (c) development of plans for instituting an NRAO archive node in Charlottesville to host GBT, 12 m, and 140 ft data, (d) construction of the pre-prototype for a Google-like free text search interface to the NRAO archive, and (e) preparation and submission of three proposals to other areas of the NSF for external funding in data visualization, scientific community resource development, and the development of software according to the Ecological Interface Design (EID) philosophy.

A transition plan was also effected to shift the management of the proposal submission tool to e2e Operations after the February 2007 proposal deadline.

Computer and Information Services (CIS)

In response to some widely publicized national news events where personal data were lost or stolen, the security committee submitted a data-security policy for formal approval by the director's office. The communication link between the VLA and the AOC was upgraded to provide enhanced support for EVLA development. The link between NRAO Charlottesville and UVa has limited the bandwidth available to transmit GBT data to the community. We have an agreement to upgrade this link in stages; the first step was completed this quarter. There were three formal security incidents during this quarter; these were localized and there were no serious consequences.

Education and Public Outreach (EPO)

The ALMA EPO Working Group, chaired by the NRAO, completed its first deliverable, a substantial revision of the ALMA brochure initially produced by the NRAO for the January 2006 American Astronomical Society (AAS) meeting. The brochure was produced via a collaborative effort of the NRAO, the European Southern Observatory (ESO), the National Astronomical Observatory of Japan (NAOJ), and the JAO, and it was released at the *Science with ALMA: A New Era in Astrophysics* meeting in Madrid in mid-November. EPO organized a face-to-face meeting of the ALMA EPO Working Group in Madrid, Spain in November to continue towards a global ALMA EPO plan.

The prize-winning images in the second annual AUI/NRAO Radio Astronomy Image Contest were announced in October. In addition to first and second prizes, the judges awarded five Honorable Mentions. EPO collaborated with Charlottesville-based Photoworks Creative Group to: (a) re-design the three exhibits deployed by the NRAO to professional astronomical community meetings; (b) design and print a 2007 NRAO Calendar; and (c) design and print two new high-quality color posters. The 2007 NRAO Calendar publishes each of the 2006 AUI/NRAO Image Contest prize-winning images. This calendar also features visually compelling astronomical images created by NRAO scientists Juan Uson, Crystal Brogan, and John Hibbard; the 2005 First Prize image by Aeree Chung; and the poster for the NRAO 50th anniversary science symposium. Two new NRAO posters were designed and printed. The first of these featured a new radio-optical composite created by Uson; the second featured the First Prize image from the 2006 AUI/NRAO image contest created by Jayanne English (University of Manitoba). The new Observatory-wide NRAO brochure was completed and printed.

The January 2007 issue of the NRAO Newsletter was completed. Ten thousand copies of this Newsletter issue were printed to support a one-time distribution to every AAS individual and institutional member. A user-friendly web interface was created to enable new on-line and hardcopy subscriptions.

The AUI-sponsored Sister Cities program was initiated. This program provides for educational and cultural exchange between San Pedro de Atacama in Chile and Magdalena, New Mexico in the United States. An opening ceremony was organized and held in San Pedro in December that included the U.S. Ambassador to Chile, and the teachers who will travel to the Magdalena in February were selected.

The ALMA brochure was revised again in December, incorporating a more North American perspective, for the American Astronomical Society (AAS) meeting in Seattle in January. EPO and scientific staff collaborated on a revision of the EVLA brochure for the AAS meeting as well as single-sheet updates describing VLBA and GBT science, instrumentation, and plans.

Interviews were conducted for the Observatory-wide Webmaster and Web Content Specialist positions.

Six press releases describing a wide range of science accomplished at NRAO facilities were distributed (2 VLA, 2 GBT, 2 other).

The second annual Charlottesville Community Open House was held November 5, 2006. More than 900 people, including many young people and teachers, visited the Observatory's Edgemont Road facilities and enjoyed a wide range of hands-on activities, talks, and demonstrations.

SCIENCE HIGHLIGHTS

Very Large Array

Giant, Ring-Like Structures Discovered Around Galaxy Cluster - Researchers using the VLA discovered giant, ring-like, radio-emitting structures around the galaxy cluster Abell 3376. The structures are believed to trace the elusive shock waves of cosmological large-scale matter flows. This discovery, combined with X-ray observations of the cluster, indicates the probable merger of a large group or small cluster with the main body, supporting the hierarchical-clustering model for the origin of large-scale structure. In addition, the large radio-emitting structures may be acceleration sites where magnetic shock could boost cosmic-ray particles to energies of 10^{18} to 10^{19} eV.

Investigators: J. Bagchi (IUCAA, Pune, India), F. Durret (Institut d'Astrophysique de Paris), G.B. Lima Neto (Instituto Astronomico e Geofisico, Sao Paulo, Brazil), and S. Paul (U. Wuerzburg, Germany).

Very Long Baseline Array

VLBA Imaging and Polarimetry Survey Completed - The VLBA Imaging and Polarimetry Survey, a 5 GHz imaging survey of more than 1100 flat-spectrum extragalactic radio sources, was observed in 2006; during the 4th quarter, the general results of this survey were accepted for publication. Automatic data reduction and classification algorithms enabled routine imaging and analysis of these 1100 images so that the survey could be published within months of the completion of the observations. A primary goal of the survey was to generate baseline images with milli-arcsec resolution of the target active galactic nuclei, most of which are expected to be detected as gamma-ray sources by the Gamma-ray Large Area Space Telescope after its launch in late 2007. In addition, approximately 20 candidate binary black holes were identified and will be followed up with the VLBA.

Investigators: J. F. Helmboldt (UNM), G. B. Taylor (UNM), S. Tremblay (UNM), C. D. Fasshacht (Univ. Calif., Davis), R. C. Walker (NRAO), S. T. Myers (NRAO), L. O. Sjouwerman (NRAO), T. J. Pearson (Caltech), A. C. S. Readhead (Caltech), L. Weintraub (Caltech), N. Gehrels (NASA/GSFC), R. W. Romani (NASA/GSFC), S. Healey (Stanford), P. F. Michelson (Stanford), R. D. Blandford (KIPAC, Stanford), and G. Cotter (Oxford, UK).

Green Bank Telescope

Laboratory and Astronomical Identification of the Negative Molecular Ion $\mathbf{C_6H^-}$ - The first negatively charged molecule in space was discovered with the GBT. While about 130 neutral and 14 positively charged molecules are known to exist in interstellar space, this is the first negative molecule, or anion, to be found. Michael McCarthy (CfA) worked with CfA colleagues Carl Gottlieb, Harshal Gupta (also from the U. of Texas), and Patrick Thaddeus to identify the molecular anion known as C_6H^-, a linear chain of six carbon atoms with one hydrogen atom at the end and an "extra" electron. Such molecules were thought to be extremely rare because the ultraviolet light that suffuses space easily knocks electrons off molecules. The large size of C_6H^-, which is larger than most neutral and all positive molecules known in space, may increase its stability in the harsh cosmic environment. They found C_6H^- in two very different locations—a shell of gas surrounding the evolved red giant star IRC +10216 in the constellation Leo and the cold molecular cloud TMC-1 in Taurus. The presence of the anion in both regions shows that the

chemical processes that form C_6H^- are ubiquitous. It also suggests that other molecular anions are present and will be found in the near future.

Investigators: M. C. McCarthy, C. A. Gottlieb, H. Gupta, and P. Thaddeus.

SCIENCE AND ACADEMIC AFFAIRS

Science and Academic Affairs (SAA) is responsible for supporting the scientific community both inside and outside the NRAO. External activities include managing the diverse student and visitor programs, scientific meetings, and the Jansky Fellowship Program, and maintaining the integrity of the telescope proposal process. Internal activities include the annual Performance Evaluation Process (PEP), tenure recommendations and promotions for the scientific staff, supervising library services and the colloquium series, and leading the Observatory Science Council (OSC).

SAA hosted the internal meeting "Future Directions for NRAO in cm/m Astronomy" and helped to organize the "Chicago II" meeting in Tucson to discuss U.S. scientific priorities. The NRAO large-proposal policy was extensively revised and a funding policy to support large proposals was developed. The very successful GBT student support program was expanded to cover all NRAO telescopes.

The assignment of scientific staff to functional support areas was completed. Two Jansky appointments ended, and two new appointments (Dan Marrone and Wei-Hao Wang) began. Two scientists in Charlottesville (Barry Turner and Qi Feng Yin) retired. The SAA division is presently developing a staffing plan that analyzes staff demographics, functional and research roles of the staff, and optimal staffing levels.

Library and Archive Programs

To mark the 50th anniversary of NRAO's founding, the NRAO Archives has posted an NRAO timeline on the web (http://www.nrao.edu/archives/Timeline/timeline.shtml) covering events leading to the establishment of the NRAO and tracing the 50 years of NRAO history since Lloyd V. Berkner and Alan T. Waterman signed the contract between Associated Universities, Inc. and the National Science Foundation on November 17, 1956. At the end of December, the Archives completed work on organizing and indexing the extensive collection of Grote Reber's papers held at the NRAO.

The Library web page is new and, we hope, more interesting. RSS feeds for radio astronomy and general science news as well as weather information for all sites have been added. Go to http://www.nrao.edu/library/ for up-to-date science or radio astronomy news and weather conditions with sunrise, sunset, moonrise, and moonset information for every NRAO site.

NRAO Summer Student Research Assistantships Program

The 2006 summer student session ended in August with 23 students completing their appointments: six at Green Bank, seven at Charlottesville, and ten at Socorro. Students submitted their final project summaries to report work that was accomplished. These project summaries can be viewed at in the www.nrao.edu/students/NRAOstudents_progsum06.pdf. The final REU/RET report was finished and submitted to NSF describing the 2006 program.

Twelve summer students presented results from their summer 2006 projects at the January 2007 AAS Meeting in Seattle, Washington. All presentations were of high quality and received much positive feedback from meeting attendees. This was a very good experience for all of the summer students.

The recruitment process for the 2007 program was continued by:

- Starting the application system for 2007 program on December 1, 2006.

- Distributing the updated NRAO REU program poster to NRAO library list of colleges and institutes nationwide.
- Updating REU-specific web and wiki sites

Graduate Student, Co-op and Visiting Scientist Programs

Yurii Pidopryhora (Ohio University) completed his Ph.D. thesis on "HI Halo Clouds: A Tool for ISM Study" under the supervision of Jay Lockman at Green Bank and Prof. Joe Shields (Ohio University). Mr. Pidopryhora's appointment with the NRAO ended in November 2006, and he has moved to a post-doctoral position with JIVE at Dwingeloo, The Netherlands. Buckner Creel (University of New Mexico) began a two-year appointment as a pre-doctoral Junior Fellow working with Mark Claussen at the Array Operations Center in November 2006. Mr. Creel's Ph.D. thesis will be on "VLBA Astrometry of Protoplanetary Nnebulae", co-supervised by Prof. Ylva Pihlstrom at the University of New Mexico.

A two-year pre-doctoral research award was made to Hirofumi Kawakubo (U. Michigan), who will work with Tim Bastian and Richard Bradley in Charlottesville and Green Bank on the development of antenna stations for low-frequency interferometric arrays, specifically for a prototype for FASR. Mr. Kawakubo will be co-supervised by Prof. Chris Ruf of the Department of Electrical Engineering and Computer Science at the University of Michigan.

Other pre-doctoral students supported by SAA during this quarter were: Kathryn Devine (University of Wisconsin) working on infrared dark clouds and high-mass star formation with Claire Chandler at the Array Operations Center and co-supervised by Prof. Ed Churchwell at the University of Wisconsin; Andrew Michael (Rochester Institute of Technology) working on multi-scale deconvolution and image reconstruction with Steven Myers at the Array Operations Center, co-supervised by Prof. Stefi Baum of the Center for Imaging Science at the Rochester Institute of Technology; Esteban Araya (New Mexico Tech) working on formaldehyde maser emission in the Galaxy with Miller Goss at the Array Operations Center, co-supervised by Prof. Peter Hofner at New Mexico Tech; and Chatalli Parashare (University of Virginia) working on instrumentation for low frequency radio astronomy arrays with Richard Bradley at the NRAO Technology Center.

Tanner Oakes (New Mexico Tech) completed his second rotation as a co-op student under the supervision of Dan Merteley at the Array Operations Center. A co-op studentship was awarded to Jesse Pomeroy (Electrical Engineering major at South Dakota School of Mines and Technology) who will begin working with Dan Merteley in January 2007.

Scientific visitors supported by SAA during this quarter were Steven Bloom (Hampden-Sydney College) and Michael Remijan (Monsanto Corp.), both in Charlottesville.

Short-term graduate student internships for the coming quarter (2007Q1) were awarded to Huib Intema (Leiden), who will work with Bill Cotton in Charlottesville on software for analysis of low-frequency observations that are severely affected by ionospheric disturbances; Claudia Cyanowski (U. of Wisconsin at Madison), who will work on a study of the high-mass star forming region S255N with Crystal Brogan in Charlottesville; and Katharine Johnston (St. Andrews), who will work on studies of disk-outflow interactions in massive protostars with Debra Shepherd at the Array Operations Center.

TELESCOPE USAGE

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The NRAO telescopes were scheduled for research and maintenance during the fourth quarter of 2006 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.

Beginning in 2005, antennas being modified for the EVLA are counted as lost for observing.

Telescope Usage (hours)			
Activity	**VLA**	**VLBA**	**GBT**
Scheduled Observing	1631.64	946.00	1708.00
Scheduled Maintenance and Equipment Changes	195.50	215.00	193.00
Scheduled Tests and Calibration	313.36	143.50	233.00
Time Lost	444.00	41.30	69.00
Actual Observing	1187.64	904.70	1639.00

GBT OBSERVING PROGRAMS

The following research programs at the indicated wavelengths were conducted with the GBT during this quarter.

No	Observer(s)	Programs	Hours Allotted
BB209	Boyce, E. (MIT) Hewitt, J. N. (MIT) Myers, S. (NRAO)	Observations of gravitational-lens central images. 6 cm wavelength	3
BB227	Braatz, J. A. (NRAO)	Measuring the extragalactic distance scale. 1.3 cm	12
BB228	Bietenholz, M. F. (York) Bartel, N. (York) Rupen, M. P. (NRAO)	The evolution of the central source in SN 1986J. 3.5 cm	27
BB231	Braatz, J. A. (NRAO) Greenhill, L. J. (CfA) Condon, J. J. (NRAO) Reid, M. J. (CfA) Henkel, C. (MPIfR) Lo, F.K. Y. (NRAO)	The megamaser cosmology project: measuring distances to NGC 6323 and Mrk 1419. 1.3 cm	41
BB233	Bietenholz, M. F. (York) Bartel, N. (York)	Does the Ursa Minor dwarf spheroidal host an intermediate-mass black hole? 6 cm	9
BB234	Boyce, E. (MIT) Winn, J. (MIT) Myers, S. (NRAO)	Investigating the third radio source in B2319+05. 6 cm	11
BM251	Miller, N. (Johns Hopkins) Wrobel, J. (NRAO) Ho, L. C. (Carnegie)	High Sensitivity Array observations of the intermediate-mass black hole in J170902+641728. 21 cm	9
BM253	Momjian, E. (Arecibo) Knudsen, K.K. (MPIA) Carilli, C. L. (NRAO) Wang, W.-H. (Hawaii)	Resolving the compact radio emission of the luminous submillimeter galaxy GOODS 850-3 at z=1.8. 21 cm	4
GBT01A-005	Turner, B. (NRAO) Langston, G. I. (NRAO)	A high-resolution spectral survey of TMC-1 at Q band. 7 mm	6
GBT02A-054	Stairs, I. (UBC) Lyne, A. G. (JBO) Kramer, M. (JBO) Athanasiadis, D. (NRAL)	High-resolution studies of a precessing pulsar. 21 cm	5
GBT04A-027	Mason, B.S. (NRAO) Bustos, R. (Concepcion) Myers, S. (NRAO) Pearson, T. J. (Caltech) Readhead, A. C. S. (Caltech) Martin, S. (Caltech) Reeves Diaz, R. (Concepcion)	Determining the high-frequency properties of mJy radio sources. 9 mm	10

4. GBT Observing Programs

No	Observer(s)	Programs	Hours Allotted
GBT04A-040	Myers, S. (NRAO) Mason, B.S. (NRAO) McMullin, J. (NRAO) Leitch, E.M. (Chicago)	Anomalous microwave emission from spinning dust grains? 3.5 cm, 9 mm	25
GBT04B-014	Kondratko, P.T. (CfA) Greenhill, L. J. (CfA) Moran, J. M. (CfA) Braatz, J. A. (NRAO)	Anchoring the extragalactic distance scale. 1.3 cm	7
GBT05B-011	Minter, A. (NRAO)	Using pulsar HI absorption to determine the distance to the local spiral arm in the second quadrant of the galaxy. 21 cm	12
GBT05C-019	Robishaw, T. (UC, Berkeley) Heiles, C. E. (UC, Berkeley)	The galactic arachnid in the Ursa Major loop. 21 cm	18
GBT05C-023	Camilo, F. (Columbia) Ransom, S. (NRAO) Gaensler, B.M. (CfA) Slane, P.O. (CfA) Lorimer, D. (WVU) Manchester, D.R. N. (ATNF)	PSR J1833-1034, the very young pulsar in the SNR G21.5-0.9. 38 cm	5
GBT05C-042	Ransom, S. (NRAO) Freire, P. (Arecibo) Hessels, J. W. T. (Amsterdam) Begin, S. (UBC) Stairs, I. (UBC) Camilo, F. (Columbia) Kaspi, V. (McGill)	Timing the binary and millisecond pulsars in NGC6440 and NGC6441. 11 cm	8
GBT05C-051	Braatz, J. A. (NRAO) Gugliucci, N. (UVA)	A snapshot survey for H_2O megamasers in nearby luminous galaxies. 1.3 cm	22
GBT06A-004	Reach, W. T. (IPAC) Palla, F. (OAA, Italy) Riccardo, V. (OAA, Italy) Morris, P. (IPAC)	Water masers from protostars in IC 1396A. 1.3 cm	4
GBT06A-014	Tarchi, A. (INAF, Italy) Henkel, C. (MPIfR) Brunthaler, A. (MPIfR) Braatz, J. A. (NRAO)	H_2O vs continuum in the megamaser 3C403: reverberation mapping of the nucleus. 1.3 cm	15
GBT06A-015	Bottinelli, S. (IfA) Ceccarelli, C. (Grenoble) Hollis, J. M. (NASA/GSFC) Remijan, A. (NRAO) Williams, J. P. (IfA)	The hot corinos of solar-type protostars. 7 mm	18
GBT06A-026	Kanekar, N. (NRAO) Ellison, S.E. (Victoria) York, B (Victoria)	A search for 21cm absorption towards MgII absorbers in the redshift desert. 50 cm	8

4. GBT Observing Programs

No	Observer(s)	Programs	Hours Allotted
GBT06A-053	Ransom, S. (NRAO) Hessels, J. W. T. (Amsterdam) Stairs, I. (UBC) Freire, P. (Arecibo) Kaspi, V. (McGill) Camilo, F. (Columbia)	Continued timing of the binary and millisecond pulsars in Terzan 5. 11 cm	21
GBT06A-054	Demorest, P. (UC, Berkeley) Backer, D. C. (UC, Berkeley) Ferdman, R. (UBC) Stairs, I. (UBC) Nice, D. (Princeton) Jacoby, B.A. (NRL) Bailes, M. (Swiburne) Ord, S. (Sydney)	Long-term precision timing of millisecond pulsars. 21 cm	56
GBT06A-056	Kondratko, P.T. (CfA) Greenhill, L. J. (CfA) Moran, J. M. (CfA)	Are there unrecognized NGC4258-like systems among known water masers in AGN? 1.3 cm	6
GBT06A-065	Friesen, R. (Victoria) Di Francesco, J. (NRC, Canada) Johnstone, D. (NRC, Canada) Shirley, Y.L. (Arizona)	Probing the initial conditions of star formation in Ophiuchus. 1.3 cm	20
GBT06A-071	Camilo, F. (Columbia) Minter, A. (NRAO) Ransom, S. (NRAO) Zimmerman, N. (Columbia) Helfand, D. J. (Columbia) Halpern, J. P. (Columbia) Reynolds, J. E. (ATNF)	Constraining the distance to the magnetar XTE J1810-197 via HI absorption. 21 cm	1
GBT06B-011	Champion, (McGill) McLaughlin, M. (WVU) Lorimer, D. (WVU)	High-precision timing a double neutron-star system. 90 cm	12
GBT06B-014	Freire, P. (Arecibo) Ransom, S. (NRAO) Gupta, Y. (NCRA)	Continued timing of the eccentric binary system in the globular cluster NGC 1851. 90 cm	21
GBT06B-015	Morgan, L. (NRAO) Urquhart, J. (Leeds) Thompson, M. (Hertfordshire)	NH_3 and CCS Mapping of Triggered Star Formation Regions. 1.3 cm	16

4. GBT Observing Programs

No	Observer(s)	Programs	Hours Allotted
GBT06B-018	Kramer, M. (JBO) Stairs, I. (UBC) McLaughlin, M. (WVU) Ferdman, R. (UBC) Camilo, F. (Columbia) Lyne, A. G. (JBO) Manchester, D.R. N. (ATNF) Possenti, A. (INAF, Italy) D'Amico, N. (INAF, Italy) Burgay, M. (INAF, Italy) Freire, P. (Arecibo)	Timing and general relativity in the double pulsar system. 21 cm	61
GBT06B-019	Minter, A. (NRAO)	Obtaining a complete sample of pulsar OH absorption with the GBT. 21 cm	6
GBT06B-028	Stairs, I. (UBC) Thorsett, S. (UC, Santa Cruz) Arzoumanian, Z. (NASA/GSFC)	Timing the planet pulsar in M4. 21 cm	3
GBT06B-032	Begin, S. (UBC) Freire, P. (Arecibo) Ransom, S. (NRAO) Stairs, I. (UBC) Hessels, J. W. T. (Amsterdam) Kaspi, V. (McGill) Camilo, F. (Columbia)	Timing of the binary and millisecond pulsars in M28. 11 cm	12
GBT06B-033	Hessels, J. W. T. (Amsterdam) Ransom, S. (NRAO SO) Kaspi, V. (McGill) Champion, (McGill) Roberts, M. (Eureka Sci)	Completing a 350 MHz survey of the galactic plane for pulsars and transients. 38 cm	4
GBT06B-034	van Gorkom, J. H. (Columbia) Carollo, C. (ETH Zurich) Lilly, S. J. (ETH Zurich) Norberg, P (Royal Obs)	Galaxy evolution in groups: HI properties of 80 2dfGRS-selected groups. 21 cm	10
GBT06B-036	Jackson, J. M. (Boston) Chambers, E. T. (Boston) Rathborne, J. (Boston) Bania, T. M. (Boston) Zhang, Q. (CfA) Wang, Y. (CfA) Simon, R. (Koln)	Pre-stellar evolution in infrared dark cloud cores. 1.3 cm	17
GBT06B-037	Weisberg, J. M. (Carleton Collge) Johnston, S. (ATNF) Koribalski, B. (ATNF) Minter, A. (NRAO) Stanimirovic, S. (UW, Maidson)	Probing the small-scale structure of molecular gas with pulsar B1641-45. 21 cm	7

4. GBT Observing Programs

No	Observer(s)	Programs	Hours Allotted
GBT06B-042	Kanekar, N. (NRAO) Ellison, S.E. (Victoria) York, B (Victoria)	The nature of damped Lyman-alpha systems, as traced by their spin temperature. 70 cm	21
GBT06B-043	Pagani, L. (Paris O, France) Herbst, E. (Ohio State) Bacmann, A. (Bordeaux O, France)	Depletion of heavy molecules in pre-stellar cores. 1.3 cm	7
GBT06B-044	Ferdman, R. (UBC) Stairs, I. (UBC) Backer, D. C. (UC, Berkeley) Burgay, M. (INAF, Italy) Camilo, F. (Columbia) D'Amico, N. (INAF, Italy) Demorest, P. (UC, Berkeley) Faulkner, A. (JBO) Hobbs, G. (ATNF) Kramer, M. (JBO) Lorimer, D. (WVU) Lyne, A. G. (JBO) Manchester, D.R. N. (ATNF) McLaughlin, M. (WVU) Nice, D. (Princeton) Possenti, A. (INAF, Italy)	Timing binary and millisecond pulsars from the Parkes Multibeam Survey. 21 cm	30
GBT06B-047	Schiminovich, D. (Columbia) Johnson, B. (Columbia) Basu-Zych, A. (Columbia) Hoopes, C. (Johns Hopkins) Heckman, T. M. (Johns Hopkins) Treyer, M. (Caltech)	HI observations of local analogs of Lyman-break Galaxies. 21 cm	11
GBT06B-055	Kanekar, N. (NRAO) Chengalur, J. (TIFR)	Confirming a new HI 21cm absorber at intermediate redshift. 38 cm	4
GBT06C-003	Remijan, A. (NRAO) Hollis, J. M. (NASA/GSFC) Lovas, F. J. (NIST) Jewell, P. R. (NRAO)	Additional transitions of interstellar methyl isocyanate (CH_3NCO) . 1.3 cm	9
GBT06C-004	Remijan, A. (NRAO) McMahon, R. J. (UW, Maidson) Widicus Weaver, S. (Illinois) McCall, B. (Illinois)	A search for o-Benzyne (o-C6H4) and Phenyl (C6H5) toward CRL 618. 1.3 cm	18
GBT06C-006	Vlemmings, W. (JBO) Chapman, J. M. (ATNF)	Searching for water-fountains. 1.3 cm	8
GBT06C-008	Srianand, R. (IUCAA, India) Gupta, N. (TIFR) Petitjean, P. (IAP, France) Saikia, D. J. (TIFR) Boisse, P. (IAP, France) Ledoux, C. (ESO)	Search for 21-cm and OH absorption in the DLAs towards Q 0405-443 (CTS 247) . 70 cm	3

4. GBT Observing Programs

No	Observer(s)	Programs	Hours Allotted
GBT06C-011	Curran, S. (UNSW) Whiting, M. (ATNF) Longmore, S. (UNSW) Webb, J. (UNSW) Bignell, R.C. (NRAO)	A pure molecular cloud at z~0.13? 21 cm	28
GBT06C-012	Curran, S. (UNSW) Whiting, M. (ATNF) Webb, J. (UNSW) Bignell, R.C. (NRAO)	A wide-band search of the source of the obscuration of reddened quasars. 21 cm	27
GBT06C-013	Curran, S. (UNSW) Tzanavaris, P. (NOA, Greece) Murphy, M. T. (Cambridge) Webb, J. (UNSW) Bignell, R.C. (NRAO)	The nature of high-redshift intervening absorption systems. 90 cm	11
GBT06C-016	Camilo, F. (Columbia) Ransom, S. (NRAO) Halpern, J. P. (Columbia) Reynolds, J. E. (ATNF) Helfand, D. J. (Columbia)	Studying the magnetar XTE J1810-197. 21 cm	35
GBT06C-017	Blanton, M. (UNC) Christiansen, W. A. (UNC) Cecil, G. N. (UNC)	Mapping the galactic-center lobe. 2 cm	3
GBT06C-018	Stairs, I. (UBC) Lorimer, D. (WVU)	Continued timing of a highly relativistic binary pulsar system. 21 cm	40
GBT06C-019	Yamamoto, S. (Tokyo) Morita, M. (Tokyo) Sakai, N. (Tokyo) Sakai, T. (Nobeyama) Takano, S. (Nobeyama)	Testing the production pathways of CCS. 1.3 cm	27
GBT06C-021	Rosolowsky, E. (CfA) Schnee, S. (Caltech) Arce, H.G. (AMNH) Caselli, P. (CfA) Goodman, A. A. (CfA) Johnstone, D. (NRC, Canada) Kaufmann, J. (MPIfR) Kirk, (Victoria) Myers, P. C. (CfA) Pineda, (CfA)	A COMPLETE census of dense cores in perseus. 1.3 cm	64
GBT06C-023	Campbell, B. (Smithsonian Inst.) Campbell, D. B. (Cornell) Carter, L. (Smithsonian Inst.) Thompson, T. (JPL) Ghent, R. (Smithsonian Inst.)	High-resolution radar studies of the moon's mega-regolith. 11 cm	12

4. GBT Observing Programs

No	Observer(s)	Programs	Hours Allotted
GBT06C-025	Kepley, A. (UW, Maidson) Wilcots, E. (UW, Maidson) Robishaw, T. (UC, Berkeley) Heiles, C. E. (UC, Berkeley) Zweibel, E. (UW, Maidson)	Magnetic fields in irregular galaxies: NGC 1156 and Holmberg II. 3.5 cm	24
GBT06C-027	Brisken, W.F. (NRAO) Macquart, J.P. (NRAO)	The impulse response of the universe. 1.3 cm	6
GBT06C-028	Matthews, B. (Herzberg) Wootten, H. A. (NRAO) Bergin, E. A. (Michigan) Crapsi, A. (Lieden Obs) Hogerheijde, H. (Leiden) Jorgensen, J. (CfA)	The kinetic temperature of the class 0 source Barnard 1c. 1.3 cm	9
GBT06C-032	Martin, P.G. (Tornota) Lockman, F. J. (NRAO) Bernard, J.P. (CESR, France) Miville-Deschenes, M. (IAS, France)	The galactic foreground at the North Ecliptic Pole. 21 cm	179
GBT06C-035	Braatz, J. A. (NRAO) Condon, J. J. (NRAO) Greenhill, L. J. (CfA) Henkel, C. (MPIfR) Reid, M. J. (CfA) Lo, F.K. Y. (NRAO) Hao, (Cornell)	The megamaser cosmology project: a survey for H_2O maser disks in SDSS AGNs. 1.3 cm	87
GBT06C-036	Cyganowski, C. (UW, Maidson) Churchwell, E. B. (UW, Maidson) Indebetouw, R. (UVA) Watson, C. (MC) Whitney, B. (SSI, Boulder)	Radio mapping of infrared interstellar bubbles. 1.3 cm	18
GBT06C-037	Lada, C. J. (CfA) Muench, A. (CfA) Rathborne, J. (Boston) Alves, J. (Calar Alto Obs) Roman-Zuniga, (CfA)	Probing the origin of dense cores and the stellar IMF. 1.3 cm	39
GBT06C-038	Lockman, F. J. (NRAO) Pidopryhora, Y. (Ohio)	GBT mapping of HI clouds in the disk-halo interface. 21 cm	42
GBT06C-039	Braatz, J. A. (NRAO) Condon, J. J. (NRAO) Greenhill, L. J. (CfA) Henkel, C. (MPIfR) Reid, M. J. (CfA) Lo, F.K. Y. (NRAO)	The megamaser cosmology project: circumnuclear disk accelerations. 1.3 cm	26
GBT06C-042	Darling, J. (Colorado) Stocke, J. T. (Colorado) Butler, B. (NRAO)	Transit of Enceladus across the southern radio lobe of 3C228. 21 cm	6

4. GBT Observing Programs

No	Observer(s)	Programs	Hours Allotted
GBT06C-045	Champion, (McGill) Kaspi, V. (McGill) Hessels, J. W. T. (Amsterdam) Woods, P. (SSI, Boulder) Thompson, C. (CITA)	A search for radio emission from magnetars after outburst. 11 cm	19
GBT06C-048	Kanekar, N. (NRAO) Ellison, S.E. (Victoria) Prochaska, J. (UC, Santa Cruz) York, B (Victoria)	HI 21cm absorption in strong MgII and CI absorbers in the redshift desert. 38 cm	42
GBT06C-049	Masters, K. (CfA) Huchra, J. (CfA) Crook, A. (MIT) Macri, L. (NOAO) Jarrett, T.H. (IPAC)	Mapping matter in the nearby universe with 2MASS. 21 cm	118
GBT06C-051	Greenhill, L. J. (CfA) Braatz, J. A. (NRAO) Henkel, C. (MPIfR) Kuiper, T. B. H. (JPL) Jauncey, D. L. (CSIRO) Lovell, J.E.J. (CSIRO) Madejski, G. M. (KIPAC) Moran, J. M. (CfA) Peck, A.B. (CfA) Wilson, A. S. (Maryland)	Monitoring two NGC4258-like masers: measurement of distances / constraint of LCDM. 1.3 cm	22
GBT06C-052	Ransom, S. (NRAO) Begin, S. (UBC) Hessels, J. W. T. (Amsterdam) Stairs, I. (UBC) Freire, P. (Arecibo) Camilo, F. (Columbia) Kaspi, V. (McGill)	Continued timing of the binary and millisecond pulsars in NGC6440 and NGC6441. 11 cm	29
GBT06C-053	Zwaan, M.A. (ESO) Peroux, C. (ESO) Liske, J. (ESO) Murphy, M. T. (Cambridge) Zych, B. (Cambridge) Bouche, N. (MPIfEP) Curran, S. (UNSW)	A search for molecules in CaII absorbers. 38 cm	7
GBT06C-055	Zwaan, M.A. (ESO) Peroux, C. (ESO) Liske, J. (ESO) Murphy, M. T. (Cambridge) Zych, B. (Cambridge) Bouche, N. (MPIfEP) Curran, S. (UNSW)	HI 21-cm absorption in MgII absorbers. 50 cm	26
GBT06C-102	Vlemmings, W. (JBO) Chapman, J. M. (ATNF)	The youngest water-fountain source OH17.7-2.0 ? 1.3 cm	3

4. GBT Observing Programs

No	Observer(s)	Programs	Hours Allotted
GBT06C-103	Kanekar, N. (NRAO) Chengalur, J. (TIFR)	Confirming a new HI 21cm absorber in the redshift desert. 50 cm	5
GBT06C-104	Chapman, S. (Cambridge) Blain, A. W. (Caltech) Lo, F.K. Y. (NRAO)	HI in AndXII, a dSph galaxy falling in from a filament. 21 cm	1
GC028	Conway, J. E. (Onsala Obs) Parra, R. (Onsala Obs) Diamond, P. J. (JBO) Lonsdale, C. J. (Haystack) Hurley, R. (Onsala Obs) Thrall, H. (JBO) Lonsdale, C. J. (IPAC) Smith, H. E. (UC, San Diego)	Sensitive high-frequency observations of the compact sources in Arp 220. 3.5 cm	24

VLA OBSERVING PROGRAMS

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

Note: "Hours observed" refers to effective hours with 27 antennas. All VLA programs during the quarter had fewer than 27 antennas because of EVLA retrofits. For example, a 27-hour program with 23 antennas observing successfully is counted as 23.0 hours of observing.

No.	Observer(s)	Programs	Hours Observed
AA307	Araya, E. (NMIMT) Hofner, P. (NMIMT) Goss, W.M. (NRAO) Kurtz, S. (MEXICO/UNAM) Linz, H. (MPIA) Olmi, L. (CNR)	Comprehensive study of the H_2CO 6cm maser in G23.71-0.20:II. 1.3 cm	1.40
AB1187	Brogan, C.L. (NRAO) Kassim, N.E. (NRL) Lazio, T.J.W. (NRL) Nord, M. (NRL)	Galactic Center mosaic at 330 MHz. 90 cm	16.26
AB1190	Birzan, L. (Ohio) McNamara, B. (Ohio) Carilli, C. (NRAO) Rafferty, D. (Ohio) Nulsen, P. (CfA) Wise, M. (MIT)	Radio sources in clusters and a group with X-ray cavities. 3.6, 6, 20 cm	11.53
AB1217	Busquet, G. (Barcelona) Estalella, R. (Barcelona) Sanchez-Monge, A. (Barcelona) Palau, A. (Barcelona)	Interaction in a closely packed environment. 3.6, 6 cm	1.83
AB1219	Brogan, C. (NRAO) Kassim, N.E. (NRL)	Probing the nature of the W51B/W51C interface using 4m and HI data. 90, 400 cm	6.97
AB1221	Borthakur, S. (Massachusetts) Yun, M. (Massachusetts) Verdes-Montenegro, L. (IAA)	High-resolution imaging to unveil the nature and origin of HI in HCGs. 20 cm	42.32
AB1222	Basu-Zych, A. (Columbia) Schiminovich, D. (Columbia) Johnson, B. (Columbia) Hoopes, C. (Johns Hopkins) Heckman, T. (Johns Hopkins)	Local analogs to LBGs. 6 cm	9.17
AB1237	Busquet, G. (Barcelona) Estalella, R. (Barcelona) Girart, J. (IEEC) Palau, A. (Barcelona)	Multiple YSOs in the low-mass star-forming region IRAS 00213+6530. 1.3 cm	0.37
AC805	Croston, J. (Hertfordshire) Hardcastle, M.H. (Hertfordshire) Kraft, R. (CfA)	Structure and spectrum of radio galaxy NGC 3801. 6 cm	0.93

5. VLA Observing Programs

No.	Observer(s)	Programs	Hours Observed
AC819	Claussen, M. (NRAO) Bond, H. (STScI) Evans, A. (Keele) Gehrz, R. (Minnesota) Healy, K. (ASU) Rushton, M. (Keele) Starrfield, S. (ASU)	Monitoring the SiO masers in V838 Monocerotis. 0.7, 1.3 cm	7.55
AC825	Chomiuk, L. (Wisconsin) Wilcots, E. (Wisconsin) Doane, N. (Wisconsin) Sanders, W. (Wisconsin) Zweibel, E. (Wisconsin)	Imaging X-ray super bubbles in nearby spiral galaxies. 6 cm	19.03
AC826	Curiel, S. (MEXICO/UNAM) Hiriart, D. (MEXICO/UNAM) Ho, P.T.P. (CfA) Patel, N. (CfA)	Imaging high-velocity SiO emission in YSO Cep A/HW2. 0.7 cm	10.90
AC827	Curiel, S. (MEXICO/UNAM) Girart, J. (Barcelona)	Structures of protostellar systems in L1448N IRS 3. 0.7, 1.3 cm	7.14
AC832	Chomiuk, L. (Wisconsin) Wilcots, E. (Wisconsin)	Systematic survey of SN remnants in star-forming galaxies. 6 cm	37.96
AC835	Chen, X. (UC, Los Angeles) Wright, E. (UC, Los Angeles)	Snapshots on two unidentified WMAP point sources. 3.6 cm	1.38
AC836	Chen, X. (UC, Los Angeles) Wright, E. (UC, Los Angeles)	Multi-wavelength obs. of three identified WMAP point sources. 3.6 cm	1.78
AC839	Cohen, A.S. (NRL) Kassim, N.E. (NRL) Kronberg, P. (Los Alamos)	Deep probe of diffuse, steep-spectrum emission in the Coma cluster. 400 cm	23.64
AC840	Clarke, T. (NRL) Schmitt, H. (NRL) Kassim, N.E. (NRL) Perley, R. (NRAO) Taylor, G. (UNM)	Low-frequency structure of the largest extragalactic radio source (Cen A). 90, 400 cm	3.77
AC841	Cannon, J.M. (Wesleyan) Rosenberg, J. (CfA) Salzer, J. (Wesleyan)	Exploring the properties of extremely compact dwarf galaxies. 20 cm	8.83
AC842	Cannon, J.M. (Wesleyan) Dolphin, A. (ASU) Kennicutt, R. (Cambridge) Lee, J. (ASU) Skillman, E. (Minnesota) Walter, F. (MPIA) Weisz, D. (Minnesota)	Multi-wavelength observations of the post-starburst dwarf galaxy DDO 165. 20 cm	3.69
AC853	Creel, B. (UNM) Claussen, M. (NRAO) Pihlstrom, Y. (UNM)	OH and H_20 maser emission survey of young planetary nebulae. 1.3 cm	9.84

5. VLA Observing Programs

No.	Observer(s)	Programs	Hours Observed
AC867	Chandra, P. (UVa) Chevalier, R. (UVa) Patat, N. (ESO)	SN 2006X: Circumstellar medium of a Type Ia SN. 3.6 cm	1.81
AD530	DeLaney, T. (CfA) Kassim, N.E. (NRL) Gaensler, B. (CfA)	Spectral-index imaging of SN 1006. 90, 400 cm	2.95
AD534	Darling, J. (Colorado) Baker, A. (Maryland)	Formaldehyde silhouettes of two EMGs against the CMB. 1.3, 3.6 cm	39.59
AD537	Darling, J. (Colorado) Stocke, J. (Colorado) Butler, B. (NRAO)	Transit of Enceladus Across the Southern radio lobe of 3C228. 20 cm	6.09
AD539	Donovan, J. (Columbia) vanGorkom, J. (Columbia) Schiminovich, D. (Columbia) Oosterloo, T. (ASTRON) Serra, P. (Groningen) Hibbard, J. (NRAO)	HI Kinematics in star-forming rings. 20 cm	25.99
AE160	Eyres, S. (Lancashire) Bode, M. (John Moores) O'Brien, T. (Manchester) Evans, N. (Texas) Muxlow, T. (Manchester) Davis, R. (Manchester) Porcas, R. (MPIfR)	Monitoring observations of RS Oph in decline. 1.3, 2, 6 cm	10.39
AF422	Furuya, R. (Caltech) Cesaroni, R. (Arcetri) Shinnaga, H. (Caltech)	Cluster of high-mass protostars in G19.61-0.23. 0.7, 6 cm	7.76
AG715	Gaensler, B.M. (CfA) Gelfand, J. (CfA) Taylor, G. (UNM) Kouvelioutou, C. (NASA) Eichler, D. (Ben Gurion Univ.) Lyubarsky, Y. (Ben Gurion Univ.) Granot, J. (KIPAC) Ramirez-Ruiz, E. (IAS) Wijers, R. (Ámsterdam) Fender, R.P. (Southampton) Garrett, M.A. (JIVE)	Imaging and monitoring of afterglow of SGR 1806-20. 3.6, 6, 20 cm	4.80
AG716	Giacintucci, S. (INAF) Venturi, T. (Bologna) Brunetti, G. (Bologna) Cassano, R. (Bologna) Dallacasa, D. (Bologna) Bardelli, S. (Bologna)	Radio galaxy in cluster A521. 3.6, 6 cm	3.88

5. VLA Observing Programs

No.	Observer(s)	Programs	Hours Observed
AG723	Giovannini, G. (Bologna) Feretti, L. (Bologna) Govoni, F. (Bologna) Murgia, M. (Bologna) Orru, e. (Bologna)	Symmetric double relics in Abell 1240 and Abell 2345. 20, 90 cm	15.97
AG724	Gitti, M. (Ohio) Feretti, L. (Bologna) McNamara, B. (Ohio)	Structure of diffuse emission from cooling-flow clusters. 20, 90 cm.	12.46
AG728	Giacani, E. (IAFE) Dubner, G. (IAFE) Bykov, A. (IOFFE) Krassilchtch, A. (IOFFE) Reynoso, E. (IAFE) Uvarov, Y. (IOFFE)	Nature of hard X-ray source detected by INTEGRAL in the Gamma-Cygni SNR. 20 cm	4.49
AG729	Govoni, F. (Bologna) Markevitch, M. (CfA) Murgia, M. (Bologna)	Deep VLA observations of relaxed clusters of galaxies. 20 cm	49.14
AG730	Greene, J. (CfA) Ulvestad, J. S. (NRAO) Ho, L.C. (Carnegie)	Nature of central massive dark objects in globular cluster G1. 3.6 cm	18.83
AG731	Giacintucci, S. (INAF) Venturi, T. (Bologna) Brunetti, G. (Bologna) Cassano, R. (Bologna) Mazzotta, P. (Roma) Bardelli, S. (Bologna) Dallacasa, D. (Bologna)	Magnetic field in the giant radio halo cluster RXCJ2003.5-2323 at z=0.317. 20 cm	11.15
AG733	Gallimore, J. (Bucknell) Axon, D. (RIT) Baum, S. (Rochester) O'Dea, C. (Rochester)	Radio relics of radio-quiet AGNs. 6 cm	4.53
AG735	Gross, C. (NRL) Clarke, T.E. (NRL) Dickel, J. (New Mexico) Kassim, N. (NRL) Weiler, K. (NRL) Brogan, C. (NRAO)	74 MHz observations of Supernova remnant IC443. 90, 400 cm	7.72
AG736	Geha, M. (Carnegie) Blanton, M. (New York University) West, A. (UC, Berkeley)	Test of gas stripping in low-mass galaxies. 20 cm	18.45
AG738	Goss, W. M. (NRAO) van der Werf, P. (Leiden) O'Dell, C. (Vanderbilt)	New search for higher-velocity HI cloudlets in Orion A: Repeat 1984 run. 20 cm	10.98
AH913	Helfand, D. (Columbia) Becker, R. (UC, Davis) White, R. (STScI)	MAGPIS: A multi array galactic plane imaging survey. 20 cm	14.79

5. VLA Observing Programs

No.	Observer(s)	Programs	Hours Observed
AH918	Hunter, D. (Lowell) Elmegreen, B. (IBM) Simpson, C. (Florida) Nordgren, T. (Redlands)	Testing a model of star formation for dwarf galaxies. 20 cm	17.28
AH919	Hankins, T. (NMIMT) Shearer, A. (Irish Centre) Sheckard, J. (NMIMT) Eilek, J. (NMIMT)	Joint VLA and integral observations of the Crab Nebula pulsar. 20 cm	2.95
AH921	Helfand, D. (Columbia) Camilo, F. (Columbia) Zimmerman, N. (Columbia) Halpern, J. (Columbia) Ransom, S. (NRAO) Reynolds, J.E. (ATNF)	Monitoring the remarkable transient AXP XTE J1810-197. 6, 20 cm	2.55
AH923	Hewitt, J.W. (Northwestern) Yusef-Zadeh, F. (Northwestern)	Nature of extended OH maser emission toward supernova remnants. 20 cm	18.51
AI121	Ivison, R. (ROE) Rieke, G. (ASU) Dunlop, J. (ROE) Owen, T. (NRAO) Blain, A. (Caltech) Hasinger, G. (MPIA) Szokoly, G. (MPE) Donley, J. (ASU) Ibar, E. (IfA)	Imaging the XMM/Newton and SHADES fields in the Lockman Hole. 20 cm	3.70
AJ329	Johnson, K. (UVa) Bandiera, R. (Arcetri) Hunt, L. (Arcetri) Ulvestad, J. S. (NRAO)	Radio supernova in the ultra-low-metallicity galaxy SBS0335-052. 3.6 cm	1.39
AK634	Kulkarni, S. (Caltech) Fox, D. (Penn State) Frail, D.A. (NRAO)	Long and short of radio afterglows in the Swift Era. 0.7, 20 cm	23.53
AK637	Klamer, I. (ATNF) Ekers, R. (ATNF) Hunstead, D. (Sydney)	325 MHz observations of high-redshift radio galaxies. 90 cm	24.90
AK640	Kepley, A. (Madison) Wilcots, E. (Wisconsin) Robishaw, T. (UC, Berkeley) Heiles, C. (UC, Berkeley) Zweibel, E. (Wisconsin)	Magnetic fields in irregular galaxies: NGC 1156 and Holmberg II. 20 cm	12.63
AK641	Kent, B. (Cornell) Stierwalt, S. (Cornell) Haynes, M. (Cornell) Giovanelli, R. (Cornell) Saintonge, A. (Cornell) Martin, A. (Cornell)	ALFALFA Dark galaxies in the Virgo Cluster. 20 cm	18.42

5. VLA Observing Programs

No.	Observer(s)	Programs	Hours Observed
AK642	Krejny, M. (Ohio) Novak, G. (Northwestern) Marrone, D. (Harvard) Shinnaga, H. (Caltech) Yusef-Zadeh, F. (Northwestern)	Probing grain size in TTS disks via multi-wavelength polarimetry. 0.7 cm	17.20
AL679	Lang, C. (Iowa) Lazio, T.J.W. (NRL) Golap, K. (NRAO)	Galactic-center magnetic environment: A 4.9 GHz Polarimetric survey. 6 cm	39.51
AL681	Linz, H. (MPIA) Henning, T. (MPIA) Hofner, P. (NMIMT) Araya, E. (NMIMT) Stecklum, B. (Thuringan)	Puzzle of BN-type massive YSOs – A case study on M8E-IR. 0.7, 1.3 cm	8.27
AM862	Monnier, J.D. (Michigan) Tuthill, P. (Sydney) Danchi, W. (NASA) Greenhill, L. (CfA)	Monitoring the colliding wind WR 112. 3.6 cm	1.38
AM871	Marti, J. (Jaen) Paredes, J. (Barcelona)	Micro-quasar powering the unidentified gamma-ray source TeV J2032+4130? 20 cm	5.42
AM873	Martini, P. (Ohio State) Boeker, T. (ESA) Schinnerer, E. (MPIA)	Testing the Schmidt Law at the end of the Hubble Sequence. 20 cm	23.30
AM874	Mundell, C. (John Moores) Schinnerer, E. (MPIA) Dumas, G. (Liverpool) Wilcots, E. (Wisconsin) Wilson, P. (Maryland) Haan, S. (MPIA)	HI Imaging survey of Seyfert galaxies – What makes galaxies active? 20 cm	26.51
AM877	Miller-Jones, J. (Amsterdam) Fender, R. (Southampton) Gallo, E. (UC, Santa Barbara) Markoff, S. (Ámsterdam) Russell, D. (Southampton)	Low frequency obs. of extended emission surrounding X-ray binary jets. 400 cm	4.36
AM880	Meier, D.S. (NRAO) Turner, J. (UC, Los Angeles) Schinnerer, E. (MPIA)	Mapping the dense star-forming cores in M51. 0.7 cm	13.82
AO210	Orienti, M. (IRA) Dallacasa, D. (Bologna) Stanghellini, C. (IRA)	High-frequency peakers: blazars or newly born radio sources? 20 cm	9.43
AO216	Ofek, E. (Caltech)	Brightest SN or new type of transient? 20 cm	2.28
AP506	Pisano, D.J. (NRL) Garland, C. (Castleton State) Guzman, R. (Florida) Gallego, J. (Florida) Castander, F. (Catalunya)	HI imaging of local luminous compact blue galaxies. 20 cm	3.72

5. VLA Observing Programs

No.	Observer(s)	Programs	Hours Observed
AR601	Riechers, D. (MPIA) Walter, F. (MPIA) Weiss, A. (MPIfR) Carilli, C. (NRAO) Bertoldi, F. (Bonn)	Search for CO emission in the z=4.4 QSO BRI 1335-0417. 1.3 cm	12.49
AR603	Rupen, M. (NRAO) Dhawan, V. (NRAO) Mioduszewski, A. (NRAO)	VLA Monitoring of and triggered response to X-ray binaries, and related sources. 0.7, 20 cm	24.71
AR606	Ramsay, G. (MSSL/UCL) Wu, K. (Univ. College, London) Slee, O.B. (ATNF) Brocksopp, C. (MSSL)	Searching for magnetic interaction in ultra-compact binaries. 6 cm	8.87
AS873	Stocke, J. (Colorado) Hart, Q. (Astro & Space Ast.)	Structure of AGN in ten clusters of galaxies. 20 cm	3.97
AS879	Stelzer, B. (Palermo) Testi, L. (Arcetri)	Search for radio emission from ultra-cool flare star LP 412-31. 3.6 cm	12.74
AS881	Suarez, O. (ESA) Gomez, J.F. (IAC) Morata, O. (ESA) Miranda, L. (IAA) Gomez, Y. (MEXICO/UNAM) Torrelles, J. (Barcelona) Anglada, G. (IAA)	H_20 and OH masers in recently detected H_20 maser-emitting planetary nebulae. 1.3, 20 cm	5.58
AS882	Sharp, M. (Chicago) Miller, A. (Columbia) Pryke, C. (Chicago) Woody, D. (Caltech) Leitch, E.M. (Chicago) Muchovej, S. (Columbia) Mroczkowski, A. (Columbia) Hennessy, R. (Chicago) Greer, C. (Chicago) Loh, M. (Chicago) Joy, M. (NASA) Carlstrom, J.E. (Chicago)	Identification of point-source contamination in SZA anisotropy fields. 3.6 cm	31.86
AS883	Saintonge, A. (Cornell) Salzer, J. (Wesleyan) Cannon, J.M. (Wesleyan) Giovanelli, R. (Cornell) Haynes, M. (Cornell) Kent, B. (Cornell) Stierwalt, S. (Cornell) Brosch, N. (Tel Aviv) Martin, A. (Cornell)	Star formation in nearby very low-surface-brightness dwarf galaxies. 20 cm	8.76

5. VLA Observing Programs

No.	Observer(s)	Programs	Hours Observed
AS884	Salzer, J. (Wesleyan) Brosch, N. (Tel Aviv) Cannon, J. (Wesleyan) Giovanelli, R. (Cornell) Haynes, M. (Cornell) Kent, B. (Cornell) Martin, A. (Cornell) Saintonge, A. (Cornell) Stierwalt, S. (Cornell)	Formation and evolution of galaxies with extremely extended HI distributions. 20 cm	8.65
AS886	Spekkens, K. (Rutgers) Sellwood, J. (Rutgers) Williams, T. (Rutgers)	Cold dark matter and dynamics of nearby spiral galaxies. 20 cm	44.48
AS887	Soderberg, A. (Caltech) Chevalier, R. (UVa) Frail, D.A. (NRAO) Kulkarni, S. (Caltech)	Toward an understanding of progenitors of Type Ibc SN. 3.6 cm	19.74
AT316	Thuan, T. (Virginia) Izotov, Y.I. (Main Astron. Obs.) Hunt, L.K. (Arcetri) Hibbard, J. (NRAO)	Continuum observations of metal-deficient blue compact dwarfs. 3.6, 6 cm	8.18
AT331	Testi, L. (Arcetri) Stelzer, B. (Palermo)	Centimeter continuum emission in Herbig Ae/Be stars. 1.3, 3.6, 6 cm	11.96
AT332	Tun, S. (New Jersey Tech) Gary, D. (New Jersey Tech)	Solar active region studies using coordinated VLA and OVSA observations. 2, 3.6, 6, 20 cm	10.49
AT333	Tripp, T. (Massachusetts) Bowen, D. (Princeton) Jenkins, E. (Princeton) Prochaska, J. (UC, Santa Cruz) Song, L. (Massachusetts) Yun, M. (Massachusetts)	Mapping the HI distribution in the unique, transforming spiral galaxy NGC 4319. 20 cm	12.91
AU111	Umana, G. (INAF) DeZotti, G. (NAF) Partridge, R. (Haverford) Trigilio, C. (INAF)	Q-band polarization properties of sample of WMAP sources. 0.7 cm	7.04
AW675	Weiler, K. (NRL) Immler, S. (NASA) Lewin, W. (MIT) Marcaide, J. (Valencia) Panagia, N. (STScI) Pooley, D. (UC, Berkeley) Ryder, S. (AAO) Sramek, R. (NRAO) Stockdale, C. (Marquette) Van Dyk, S. (Caltech)	Core collapse SN (Type II). 3.6 cm	4.06

5. VLA Observing Programs

No.	Observer(s)	Programs	Hours Observed
AW683	Walter, F. (MPIA) Brinks, E. (Hertfordshire) Skillman, E. (Minnesota)	New population of HI clouds in M81 group. 20 cm	22.44
AW687	Wilcots, E. (Wisconsin) Hess, K. (Wisconsin)	Fossil halos and the heating of the intra-group medium. 90, 400 cm	11.80
AW693	Willott, C. (Hertzberg-Victoria) Martinez-Sansigre, A. (Oxford) Rawlings, S. (Oxford)	High-resolution molecular gas imaging in the dust-reddened quasar 3C318. 0.7 cm	5.46
AY171	Yun, M. (Massachusetts) Borthakur, S. (Massachusetts) Verdes-Montenegro, L. (IAA)	Tracing large-scale shocks in three Hickson compact groups. 20 cm	8.47
AZ169	Zapata, L.A. (CfA) Ohashi, N. (ASIAA)	Dust-size evolution in circumstellar disk around AB Aur? 0.7 cm	1.79
BB209	Boyce, E. (MIT) Hewitt, J. (MIT) Myers, S. (NRAO)	Observations of gravitational-lens central images. 3.6, 6 cm	3.13
BB228	Bietenholz, M.F. (York) Bartel, N. (York) Rupen, M. (NRAO)	Evolution of central source in SN 1986J. 1.3, 3.6 cm	25.67
BB231	Braatz, J. (NRAO) Condon, J. (NRAO) Greenhill, L. (CfA) Henkel, C. (MPIfR) Lo, K.Y. (NRAO) Reid, M. (CfA)	Megamaser cosmology project. 1.3 cm	0.92
BB234	Boyce, E. (MIT) Winn, J.N. (MIT) Myers, S.T. (NRAO)	Investigating the third radio source in B2319+051. 6, 20 cm	8.94
BD114	Dougherty, S. (DRAO) Pittard, J. (Leeds) O'Connor, E. (UPEI) Beasley, A.J. (NRAO) Claussen, M.J. (NRAO)	Structural monitoring of colliding-wind binary WR140. 2, 3.6, 6 cm	12.05
BM251	Miller, N. (Johns Hopkins) Wrobel, J. (NRAO) Ho, L.C. (Carnegie)	HSA Observations of intermediate-mass black hole in J170902+641728. 20 cm	3.30
BM253	Momjian, E. (Arecibo) Knudsen, K. K. (MPIA) Carilli, C. (NRAO) Wang, W.-H. (Hawaii)	Compact radio emission of the luminous SMG GOODS 850-3 at z=1.8. 20 cm	6.45
GA023	Anderson, J.M. (JIVE) Noordam, J. (Dwingeloo)	Wide-field ionospheric calibration for VLBI. 90 cm	4.35

5. VLA Observing Programs

No.	Observer(s)	Programs	Hours Observed
GC028	Conway, J. (Onsala) Parra, R. (Onsala) Diamond, P. (Manchester) Lonsdale, C.J. (Haystack) Hurley, R. (Onsala) Thrall, H. (Manchester) Lonsdale, C.J. (Caltech) Smith, H.E. (CfA)	Sensitive high-frequency observations of the compact sources in Arp 220. 2, 3.6 cm	18.27
S80303	Migliari, S. (Amsterdam) Tomsick, J. (Calif.-San Diego) Gallo, E. (Calif.-Santa Barbara) Maccarone, T. (Southampton) Fender, R. (Southampton) Nelemans, G. (IoA) Jonker, P. (CfA)	Multi-wavelength observations of compact jets in a neutron-star X-ray binary. 3.6, 6 cm	11.18
S80394	Sanders, J. (Cambridge) Fabian, A. (Cambridge) Taylor, G. (UNM) Dunn, R. (Cambridge)	Cluster and AGN interaction in 2A 0335+096. 3.6, 6 cm	3.70
S80576	Forman, W. (CfA) Sun, M. (MSU) Baum, S. (Rochester) O'Dea, C. (Rochester) Jones, C. (CfA)	Interaction of AGN outbursts with their environments. 6, 20 cm	3.69
S70601	Forman, W.R. (CfA) Jones, C. (CfA) Charasov, E. (MPA) Eilek, J. (NMIMT) Owen, F. (NRAO)	Chandra/VLA observations of galaxy IC 1262. 90 cm	1.37
S70810	Miller, J. (Michigan) Grindlay, J. (CfA) vanderKlis, M. (Amsterdam) Wijnands, R. (Amsterdam) Mendez, M. (Utrecht-SRON) Raymond, J. (CfA) Rupen, M. (NRAO) Steeghs, D. (CfA)	Chandra/VLA observations of neutron-star binaries. 3.6, 6 cm	1.85

VLBA OBSERVING PROGRAMS

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

Note: "Hours observed" is scaled by the fractional number of operational antennas. For example, a 10 hr. run with 9 of 10 VLBA antennas operational counts as 9.0 hours observed.

No.	Observer(s)	Programs	Hours Observed
BA078	Agudo, I. (MPIfR) Bach, U. (Torino) Gomez, J.L. (IAA) Krichbaum, T. (MPIfR) Roy, A. (MPIfR) Witzel, A. (MPIfR) Zensus, J.A. (MPIfR)	Monitoring NRAO 150 with multi-frequency polarimetry. 1, 2, 4 cm	12.0
BA080	Asada, K. (NAOJ) Inoue, M. (NAOJ)	Trimonthly monitoring observation of the helical magnetic field in 3C 273 jet. 2, 4, 6 cm	8.0
BA082	Agudo, I. (MPIfR) Gomez, J.L. (IAA) Jorstad, S. (Boston) Lobanov, A. (MPIfR) Marscher, A. (Boston) Marti, J. (Valencia) Perucho, M. (MPIfR) Roca-Sogorb, M. (IAA) Roy, A. (MPIfR)	Astrometry of wobbling jets in blazars. 0.7, 1 cm	16.0
BB209	Boyce, E. (MIT) Hewitt, J. (MIT) Myers, S. (NRAO)	Observations of gravitational-lens central images. 6 cm	2.50
BB225	Bartkiewicz, A. (Torun) Brunthaler, A. (MPIfR) Szymczak, M. (Torun) van Langevelde, H. (JIVE)	Nature of methanol maser ring around a young massive star. 2 cm	10.0
BB227	Braatz, J.A. (NRAO)	Imaging the water megamaser in galaxy UGC 3789. 1.3 cm	12.0
BB228	Bietenholz, M.F. (York)	Evolution of central source in SN 1986J. 1.3, 3.6 cm	30.0
BB231	Braatz, J.A. (NRAO) Greenhill, L. (CfA) Condon, J. (NRAO) Reid, M. (CfA) Henkel, C. (MPIfR) Lo, K.Y. (NRAO)	Megamaser cosmology Project: Measuring distances to NGC 6323 and Mrk 1419. 1.3 cm	40.0
BB233	Bietenholz, M.F. (York) Bartel, N. (York)	Does the Ursa Minor dwarf spheroidal host an intermediate-mass black hole. 6 cm	8.0

BB234	Boyce, E. (MIT) Winn, J.N. (MIT) Myers, S. (NRAO)	Investigating the third radio source in B2319+051. 6, 19 cm	10.0
BC167	Cheung, C. (Stanford) Harris, D.E. (SAO) Junor, W. (LANL)	Continued monitoring of Knot 'HST-1" in the M87 jet. 20 cm	7.80
BD114	Dougherty, S. (DRAO) Pittard, J. (Leeds) O'Connor, E. (UPEI) Beasley, A.J. (NRAO)	Structural monitoring of colliding-wind binary WR140. 0.7, 1.3, 2, 3.6, 6 cm	12.00
BE044	Edwards, P. (ISAS) Falcone, A. (Penn State) Horan, D. (SAO) Jung, I. (Washington Univ.) Krawczynski, H. (Washington Univ.) Piner, G. (Whittier)	Doppler crisis. 6 cm	44.0
BE047	Edwards, P.G. (ISAS) Piner, G. (Whittier)	PG 1553+113 – new TeV blazar. 1 cm	10.0
BH136	Hachisuka, K. (MPIfR) Brunthaler, A. (JIVE) Hagiwara, Y. (NAOJ) Menten, K. (MPIfR) Mochizuki, N. (ISAS) Reid, N. (CfA)	Astrometry of H_20 maser sources in outer part of the galaxy. 1 cm	6.0
BI033	Imai, H. (Kagoshima) Deguchi, S. (Nobeyama) Kwok, s. (Hong Kong) Nakashima, J. (ASIAA)	Mapping the two newly found water fountains with the VLBA. 1 cm	8.0
BJ061	Jones, D. (JPL) Border, J. (JPL) Fomalont, E. (NRAO) Preston, B. (JPL) Romney, J. (NRAO) Standish, M. (JPL)	Improvement of Saturn Ephemeris through VLBA obs. of Cassini spacecraft. 4 cm	3.0
BK132	Kharb, P. (Rochester) Baum, S. (Rochester) O'Dea, C. (Rochester)	Radio core in Markarian 6. 6, 20 cm	12.0
BL128	Loinard, L. ((MEXICO/UNAM) Mioduszewski, A. (NRAO) Rodriguez, L. (MEXICO/UNAM) Torres, R. (MEXICO/UNAM)	Distance to Taurus and Ophiuchus from multi-epoch VLBA observations. 4 cm	8.0
BL137	Lister, M. (Purdue) Aller, H.D. (Michigan) Aller, M.F. (Michigan) Arshakian, T. (MPIfR) Homan, D. (Denison)	MOJAVE II Program. 2, 4 cm	76.0

BL139	Lobanov, A. (MPIfR) Alef, W. (MPIfR) Arshakian, T. (MPIfR) Chavushyan, V. (INAOE) Mercado, A. (INAOE) Shapovalova, A. (SAO)	Parsec-scale radio emission, accretion disk and broad-line region in 3C 390.3. 0.7, 1, 2 cm	8.0
BL147	Loinard, L. (MEXICO/UNAM) Mioduszewski, a. (NRAO) Rodriguez, L.F. (MEXICO/UNAM) Torres, R.A. (MEXICO/UNAM)	Mapping out the distribution of nearby star-forming regions and molecular complexes. 4 cm	15.0
BM132	Migenes, V. (Guanajuato) Altunin, V. (JPL) Horiuchi, S. (NAOJ) Ludke, E. (CCNE) Mendoza, E. (INAOE) Sylsh, S. (ASC)	Search for small angular sized OH maser regions. 20 cm	5.0
BM239	Moscadelli, L. (Cagliari) Claussen, M. (NRAO) Furuya, R. (Caltech) Goddi, C. (Cagliari) Kitamura, Y. (ISAS) Testi, L. (Arcetri) Wootten, H.A. (NRAO)	Absolute proper motions of H_20 masers in Serpens SMM1. 1 cm	16.0
BM247	Marscher, A.P. (Boston) Aller, M.F. (Michigan) Chatterjee, S. (Boston) Jorstad, S. (Boston) McHardy, I. (Southampton)	Relation between the X-ray state and energy flow into jets of radio galaxies. 0.7 cm	48.0
BM248	Marscher, A. (Boston) Aller, M.F. (Michigan) D'Arcangelo, F. (Boston) Hagen-Thorn, V. (St. Petersburg) Jorstad, S. (Boston) Larionov, V. (St. Petersburg) McHardy, I. (Southampton)	Probing compact jets through multi-waveband variability and polarization. 0.7 cm	32.0
BM251	Miller, N. (Johns Hopkins) Wrobel, J. (NRAO) Ho, L.C. (Carnegie)	HSA Observations of weak radio sources at high frequencies. 4, 13 cm	8.0
BM252	Majid, W. (JPL) Bagri, D. (JPL) Fomalont, E. (NRAO)	Compactness of weak radio sources at high frequencies. 4, 13 cm	20.0
BM253	Momjian, E. (Arecibo) Knudsen, K.K. (MPIA) Carilli, C. (NRAO) Wang, W.-H. (Hawaii)	Compact radio emission of the luminous SMG GOODS 850-3 at z=1.8. 18 cm	7.0

BP125	Petrov, L. (NVI) Fomalont, E. (NRAO) Gordon, D. (NASA) Honma, M. (NAOJ) Kobayashi, H. (NAOJ) Kovalev, Y.Y. (NVI)	GaPS: Galactic Plane Survey. 1 cm	24.0
BP128	Peck, G. (CfA) Marrone, D. (Harvard) Myers, S. (NRAO) Taylor, G. (UNM) Zavala, B. (USNO)	Multi-wavelength analysis of record outburst in 3C454.3. 1, 2, 4, 6 cm	6.0
BP131	Piner, B.G. (Whittier) Edwards, P.G. (ISAS)	Toward establishing a confirmed sample of ultra-relativistic jets. 0.7 cm	12.0
BP133	Petrov, L. (NASA) Fomalont, E. (NRAO) Gordon, D. (NASA) Kovalev, Y.Y. (ASC)	Follow-up of VLBA calibrator survey. 4, 13 cm	24.0
BP134	Piner, B.G. (Whittier) Edwards, P.G. (CSIRO) Jones, D.L. (JPL)	Persistent 26c component in the blazar 0827+243. 0.7, 4 cm	6.0
BP136	Perez-Torres, M. (IAA) Alberdi, A. (IAA) Cortina, J. (IFAE) Guerrero, N. (IAA) Prada, F. (IAA) Rico, J. (IFAE) Sanchez-Conde, M. (IAA) Sidro, N. (IFAE)	VLBA Imaging of gamma-ray binary LS1+61303. 6 cm	11.0
BP138	Petrov, L. (NVI) Gipson, J. (NVI) Gordon, D. (Raytheon) Ma, C. (NASA) MacMillan, D. (NVI)	Measurement of post-seismic diplacement of MK-VLBA caused by the Hawaii earthquake on 2006.10.15. 4, 13 cm	24.0
BR100	Reid, M. (CfA) Greenhill, L. (CfA) Menten, K. (MPIfR) Moscadelli, L. (Cagliari) Xu, Y. (Nanjing) Zheng, X.W. (Nanjing)	Spiral structure and kinematics of the Milky Way. 2 cm	39.75
BR121	Reid, M. (CfA) Brunthaler, A. (MPIfR) Menten, K. (MPIfR) Xu, Y. (MPIfR) Zheng, X.-W. (Nanjing)	Trigonometric parallax for the Galactic Center. 1 cm	16.0
BS150	Savolainen, T. (Tuorla) Rastorgueva, E. (Tuorla) Takalo, L. (Tuorla) Valtaoja, E. (Tuorla)	Multi-frequency Polarimetric VLBA monitoring of next predicted outburst in OJ287. 0.3, 0.7, 1, 2,	8.0

BS160	Shen, Z. (ShAO) Chen, X. (ShAO) Jiang, D. (ShAO)	Simultaneous observations of three 7mm SiO masers toward VX Sgr at five epochs. 0.7 cm	8.
BS169	Stanghellini, C. (Bologna) Venturi, T. (Bologna) Dallacasa, D. (Bologna) Tao, A. (ShAO) Xiao-Yu, Hong (ShAO)	Hot-spot separation velocity in three compact symmetric objects. 4 cm	16.25
BS170	Stark, D. (Caltech) Churchwell, E. (Wisconsin) Fish, V. (NRAO) Goss, W. M. (NRAO) Hoffman, I. (Cleriq Arts & Science)	Speedy OH masers in G5.886-0.39. 20 cm	6.0
BT087	Tafoya, D. (CfA) Gomez, Y. (MEXICO/UNAM) Patel, N. (CfA) Reid, M. (CfA)	Rotating magnetized disk in young planetary nebula K3-35. 20 cm	9.25
BT088	Taylor, G. (UNM) Fassnacht, C. (UC, Davis) Healey, S. (Stanford) Helmboldt, J. (UNM) Myers, S. (NRAO) Pearson, T. (Caltech) Readhead, T. (Caltech) Romani, R. (Stanford) Sjouwerman, L. (NRAO) Walker, R. C. (NRAO) Weintraub, L. (Caltech)	Investigating supermassive binary black-hole candidates. 2, 4, 6 cm	34.0
BV059	Vlemmings, W.H.T. (Manchester) Torrelles, J. (Barcelona) vanLangevelde, H. (JIVE)	Co-evolution of methanol and water-maser filaments in Cepheus A star-forming region. 1 cm	5.0
BW077	Walker, R. C. (NRAO) Benson, J. (NRAO) Hardee, P. (Alabama)	Constraining possible helical flow in 3C120 at 1.7 GHz. 20 cm	12.50
BW086	Wiik, K. (Tuorla) Savolainen, T. (Tuorla)	Multi-frequency Polarimetric VLBA follow up of 3C454.3. 0.3, 0.7, 1, 2, 4, 6 cm	24.0
BZ034	Zavala, R.T. (USNO) Boboltz, D. (USNO) Hutter, D. (USNO) Ojha, R. (USNO) Richards, M. (Penn State) Shaffer, D. (Radiometrics) Tycner, C. (USNO)	Testing of the radio emission in Algol. 6 cm	70.0

6. VLBA Observing Programs

GA022	Agudo, I. (MPIfR) Krichbaum, T.P. (MPIfR) Gomez, J-L. (Barcelona) Bach, U. (Torino) Bremer, M. (IRAM) Witzel, a. (MPIfR) Zensus, J.A. (MPIfR)	Polarimetric monitoring of NRAO 150. 0.3 cm	12.0
GA023	Anderson, J.M. (JIVE) Noordam, J. (Dwingeloo)	Wide-field ionospheric calibration for VLBI. 90 cm	4.0
GC028	Conway, J.E. (Onsala) Parra, R. (Onsala) Diamond, P. (Manchester) Lonsdale, C.J. (Haystack) Hurley, R. (Onsala) Thrall, H. (Manchester) Lonsdale, C.J. (Caltech) Smith, H.E. (CfA)	Sensitive high-frequency observations of the compact source s in Arp 220. 2, 3.6 cm	28.0
GD022	Dodson, R. (OAN) Agudo, I. (IAA) Krichbaum, T.P. (MPIfR) Thum, C. (IRAM) Wiesemeyer, H. (IRAM) Rioja, M.J. (OAN) Bremer, M. (IRAM)	Polarization observations with GMVA. 0.3 cm	5.0
GK037	Kudryavtseva, N. (MPIfR) Britzen, S. (Heidelberg) Krichbaum, T.P. (MPIfR) Witzel, A. (MPIfR) Zensus, J.A. (MPIfR) Larionov, V.M. (St. Petersburg) Hagen-Thorn, V. (St. Petersburg)	Monitoring of BL Lac object S5 1803+784. 0.3 cm	12.0
GR026	Rastorgueva, E.A. (Tuorla) Wiik, K. (Tuorla) Savolainen, T. (Tuorla) Takalo, L. (Tuorla) Krichbaum, T. (MPIfR)	Monitoring the next predicted outburst in OJ287 at 86 GHz. 0.3 cm	11.0
RDV60	Johnston, K. (USNO) Fey, A. (USNO) Ma, C. (NASA) Gordon, D. (Raytheon) Boboltz, D. (USNO) Kingham, K. (USNO) Behrend, D. (USNO) Gipson, J. (NVI) MacMillan, D. (NVI) Petrov, L. (NASA) Fomalont, E. (NRAO) Walker, R.C. (NRAO)	Geodesy/astrometry observations for 2006. 3. 6 cm	24.0

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ARAYA, E.; HOFNER, P.; SEWILO, M.; LINZ, H.; KURTZ, S.; OLMI, L.; WATSON, C.; CHURCHWELL, E. "First Detection of an H_2CO 6 cm Maser Flare: A Burst in IRAS 18566+0408."

ASZTALOS, S.; DAW, E.; PENG, H.; ROSENBERG, L.J.; HAGMANN, C.; KINION, D.; STOEFFL, W.; VAN BIBBER, K.; SIKIVIE, P.; SULLIVAN, N.S.; TANNER, D.B.; NEZRICK, F.; TURNER, M.S.; MOLTZ, D.M.; POWELL, J.; ANDRÉ, M.-O.; CLARKE, J.; MÜCK, M.; BRADLEY, R.F. "Large-Scale Microwave Cavity Search for Dark-Matter Axions."

ASZTALOS, S.J.; BRADLEY, R.F.; DUFFY, L.; HAGMANN, C.; KINION, D.; MOLTZ, D.M.; ROSENBERG, L.J.; SIKIVIE, P.; STOEFFL, W.; SULLIVAN, N.S.; TANNER, D.B.; VAN BIBBER, K.; YU, D.B. "Improved RF Cavity Search for Halo Axions."

BAARS, J.W.M.; GENZEL, R.; PAULINY-TOTH, I.I.K.; WITZEL, A. "The Absolute Spectrum of Cas A; An Accurate Flux Density Scale and a Set of Secondary Calibrators."

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BESWICK, R.J.; MUXLOW, T.W.B.; THRALL, H.; RICHARDS, A.M.S. "Sub-Arcsecond, microJy Radio Properties of Spitzer identified Mid-Infrared Sources in the HDF-N/GOODS-N Field."

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BOUTON, E.N. "Starting With Nothing: Archives at National Radio Astronomy Observatory."

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BRADLEY, R.E.; HOBURG, J.A. "Electrohydrodynamic Augmentation of Forced Convection Heat Transfer."

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EXPANDED VERY LARGE ARRAY

Expanded Very Large Array Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Implement antenna auto-phasing	06/05/06	10/03/06	10/03/06
2. Start EVLA conversion of antenna 17	10/04/06		10/04/06
3. Develop plan to insulate antenna feed-cone metal	10/20/06		10/23/06
4. L-band wideband receiver installed	04/21/06	10/30/06	10/24/06
5. Baseline Board prototype available	08/30/06	10/16/06	10/25/06
6. Complete mechanical design of Ka-band RF tree	10/30/06		10/30/06
7. Install prototype F317 in antenna	10/17/06		11/03/06
8. Complete Part 2 hardware bench integration	03/03/03	11/01/06	11/06/06
9. Complete L-band OMT fabrication drawings	11/10/06		11/10/06
10. Write SNOW program to prevent snow accumulation	11/13/06		11/13/06
11. New VLA correlator controller controlled from EVLA M&C system	11/30/05	12/22/06	11/13/06
12. Specify extensions to EVLA script and obs2script	10/17/05	10/16/06	11/20/06
13. Linearity of RF design model	08/12/05	10/30/06	11/20/06
14. AOC-VLA data link upgraded	11/15/06		11/21/06
15. Correlator shielded chamber completed	11/21/06		11/21/06
16. Implement visibility data record	12/29/06		11/27/06
17. Final testing of VLA setup in the Observation Executor	11/30/06		11/30/06
18. Start EVLA conversion of antenna 21	12/05/06		11/30/06
19. Hardware acceptance tests complete on antenna 26	10/12/06		12/01/06
20. Antenna 26 turnover to Operations	10/13/06		12/04/06
21. Monitor and Control CDR	12/05/06		12/06/06
22. Functional test of visibility pipe	12/15/06		12/15/06
23. ESO-ALMA NGAS hardware/software installed	08/31/06	12/15/06	12/15/06
24. EVLA CASA testing started	12/18/06		12/18/06
25. L-band sensitivity tests with wideband receiver	09/08/06	11/10/06	12/18/06
26. Hardware acceptance tests complete on antenna 23	11/02/06	01/12/07	
27. Implement tipping curves for opacity determination	10/16/06	01/16/07	
28. C-band OMT - broadband test in receiver	08/31/06	01/16/07	
29. Antenna 23 turnover to Operations	11/03/06	01/16/07	
30. Implement listener thread in Observation Executor	12/18/06	01/22/07	

PROJECTS

1. Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
31. GUI interface to hardware reset synchronization tool	01/29/07		
32. Correlator output data format defined	01/29/07		
33. Updated High-Level Architecture	05/01/06	01/30/07	
34. Conduct risk and contingency analysis	12/12/06	01/31/07	
35. Select fabrication method for L-band OMT	01/31/07		
36. Assemble Ka-band RF tree	02/01/07		
37. Visibility data available in EVLA M&C system	02/05/07		
38. Hardware acceptance tests complete on antenna 17	02/07/07		
39. Antenna 17 turnover to Operations	02/08/07		
40. Start EVLA conversion of antenna 19	02/13/07		
41. Correlator 48v DC plant installed	02/14/07		
42. OPT outputs a VLA observe script	10/25/06	02/15/07	
43. Archive records written using Modcomp-independent format	03/13/06	02/15/07	
44. VLBA data in ALMA science data model	05/08/06	02/15/07	
45. Receive "Science View" of Project Data Model from ALMA	02/16/07		
46. VLA Operators able to run Modcomp replacement system	02/20/07		
47. Review of ALMA science data model	02/20/07		
48. Provide capability for moving-source observation	12/18/06	02/20/07	
49. Assemble prototype Ka-band receiver	02/28/07		
50. Begin production of C-band OMT	02/28/07		
51. M302/3 utility module evaluated on antenna	02/28/07		
52. Tests of Observation Executor running VLA	03/01/07		
53. GUIs available for initial EVLA antenna operations checkout	06/01/06	03/02/07	
54. ESDM definition	03/12/07		
55. Final agreement between EVLA & ALMA on "Science View" of the Project Data Model (PDM)	11/01/06	03/15/07	
56. Assemble prototype S-band feed	03/16/07		
57. Install wideband C-band receiver on antenna	11/02/06	04/30/07	
58. Access to archive tool via portal	06/14/06	12/15/07	

PROJECTS

1. Expanded Very Large Array

Project Management

A risk analysis workshop was held on December 12, 2006 to identify potential risks to the project and to develop any necessary risk mitigation procedures. A risk register was developed, and the risks will be formally tracked on a quarterly basis to determine if they can be retired or if corrective action is required.

Antennas and Systems Integration

The outfitting and testing of antenna 26 was completed, and it has been returned to the array for astronomical observations. The outfitting of antenna 23 with EVLA electronics is complete, and tests of this antenna are under way. It should be returned to the array in mid-January 2007. The outfitting of antenna 17 is nearly complete. After additional receivers and the T303 UX (U band to X band) converter are installed on antenna 17, it will likely be used for system testing to evaluate modifications to the local-oscillator and data-transmission systems before it is returned to operations in late January for astronomical observations. Antenna 21 is currently in the antenna assembly building for its mechanical overhaul. The assembly of the equipment racks for antenna 21 is nearly complete.

Testing of modules and other system hardware continue in an effort to better understand the jumps and drifts in visibility phase that are being seen in the system. Laboratory tests have been under way for several months, and test results have already led to some changes in the hardware. These changes mostly involve RF interconnect and thermal issues. System tests using the modified hardware in the antennas are planned for the third week of January 2007. These tests are designed to enable us to evaluate the performance of the changes that have been made and to narrow down the problems to specific parts of the system. The newest version of the round-trip-phase hardware will also be installed and tested at the same time.

The temperature sensors and firmware in the DC power supplies have now been completed and tested for the P301 and P302 DC/DC converter modules for the antennas. This design is now ready for production. The newly functional temperature sensors in the modules will improve system protection and help to monitor thermal conditions during the phase-stability testing.

Civil Construction

The assembly of the correlator shielded room is complete, and most of the room's infrastructure has been installed. The startup of the correlator room's HVAC equipment was completed in December 2006. Training on the operation of the HVAC system will be completed in February 2007. The FM200 fire suppression and pre-action sprinkler systems were completed and put into operation in December 2006. The FM200 gas cylinders will be activated after the correlator is installed. The delivery of the correlator's -48V power plant is scheduled for February 2007. The assembly and startup of the power plant are scheduled for March and April 2007, respectively.

Local Oscillator System

All local oscillator (LO) modules, except for the round-trip-phase module, are in full production. Despite problems with early prototypes, the current version of the synthesizers is working fairly well. There are only a few minor problems that still need to be addressed. The new design of the round-trip-phase modules is scheduled to be tested in the array in January and February of 2007. Global phase jumps on the array were traced to the L350 Central LO Reference Generator. The phase jumps are still under

investigation. Temperature gradients within the L350 module have been discovered, and the effect of the gradients on phase stability is also under investigation. Retrofits on existing LO modules are planned to start in the fall of 2007.

Fiber Optics

Modules for the Digital Transmission System (DTS), formatter, and de-formatter continue to be built to meet the antenna outfitting schedule. The installation of fiber-optic cable on antenna 21 is 70% complete, with the remaining work being the splicing of the optical fibers.

The design of the 3-bit, 4 Gsps sampler was shown to meet its performance specification, but it is now being re-examined because of the availability of the Rockwell digitizer chip. Rockwell requires the NRAO to pay all non-recurring engineering costs, making the cost of the design exceed the initial estimate. Other sources and designs are being investigated, including a digitizer chip used by the ALMA project and a digitizer chip that may be commercially available from Tektronix.

The non-metallic conduit used to protect the fiber-optic cable that runs up the outside of antenna 23 broke at the elevation cable wrap owing to cold weather and incorrect installation. The fiber-optic cable was not damaged, but the incident revealed the need to change the material being used. A temporary patch has been installed and a newer, stronger, and more flexible conduit has been procured. The conduit on antenna 23 will be replaced in early 2007.

Intermediate Frequency System

All intermediate-frequency (IF) modules, except for the 4P IF-converter module, are in full production. The 4P converters have been redesigned and now seem to meet specifications. The baseband converter is still lacking the gain-slope equalizer filters. The latest design of the gain-slope equalizer meets specification, and it will start to be incorporated in the fall of 2007. As with the LO modules, retrofits of existing IF modules are planned to start in the fall of 2007.

Front End

Antenna 23, the seventh EVLA antenna to be upgraded, received its interim 8–12 GHz and 1.2–2.0 GHz front ends in October 2006. Antenna 17, the next in line, had its 8–12 GHz receiver installed in December. Its 1.2–2.0 GHz receiver, which has been modified with new balanced amplifiers and a hybrid coupler polarizer, passed all of its RF tests before the end of the year. The 18–27 GHz systems for antennas 23 and 17 are undergoing final RF testing in the laboratory and will be installed in January 2007. It is worth noting that the 18–27 GHz receiver being prepared for antenna 23 will be 100% EVLA-compliant, including all of its ancillary electronic systems.

The EVLA L-Band prototype receiver, with the first wideband 1–2 GHz orthomode transducer (OMT), was installed on antenna 14 in November 2006. A series of sensitivity and efficiency measurements, using both the tried and true RF-power-meter technique and the new DTS bandpass-spectrum tool, are under way. Additional G/T versus frequency comparison tests are also being carried out on antenna 24, which has a 1.2–2.0 GHz interim receiver. An EVLA memorandum documenting these test results is in preparation.

1. Expanded Very Large Array

The 4–8 GHz receiver originally slated for antenna 26 is currently being used for the first cooled tests of the new wideband 4-8 GHz OMT prototype. Initial tests are promising, but the receiver temperature has several resonances in the passband which are being investigated. Owing to narrowband polarizer and LNA delivery issues, the interim 4–8 GHz receivers for antennas 23 and 17 were delayed. We are now modifying the 4.5–5.0 GHz circular polarizers salvaged from the old VLA C-Band receivers as a temporary stopgap until the new 4–8 GHz polarizer enters mass production. Interim receivers will be installed on these antennas before the end of January 2007.

Owing to fabrication issues with the 40–50 GHz MMIC post-amps, the delivery of the 40–50 GHz receivers for antenna 26, 23, and 17 were delayed. These receivers will be installed during the first quarter of 2007.

The design of the card cage, which provides the interface between a receiver and the EVLA M&C system and its six associated circuit boards, has been finalized. A comprehensive bill of materials has been drawn up in preparation for a final production order early in 2007. The assembly of the DC Distribution Box has been out-sourced to VLBA Owens Valley. Enough parts to build the final 40 boxes have been ordered.

The cryogenics group has built 32 Scott-T boxes, which are used to drive the refrigerators in the receivers. This is half of the project's requirements. The cryogenics group is also building the utility rack (formerly known as the F-rack). A new utility rack has been delivered for each new EVLA antenna during the past quarter. The layout of the rack has been finalized and has been considerably improved for ease of production. In addition, the cable assemblies for 10 more racks are complete.

Correlator

Prolonged problems with the fabrication of the correlator's printed circuit boards appear to be resolved, and board testing is now under way at the DRAO in Penticton, British Columbia. An NRAO software engineer, who is responsible for integrating the correlator into the EVLA monitor and control system, has been working in Penticton in support of the tests.

A reliability analysis conducted early in the project had indicated that more spare correlator boards were required than originally planned, which would have resulted in a significant shortfall in the project budget. The spare-board count was driven by the number of times components can be replaced on a board (a "rework"). A re-evaluation of the boards shows that the number of reworks can be much larger than originally assumed, by up to a factor of ten. Therefore, the number of spare boards required and the potential budget shortfall is greatly reduced.

The installation of the prototype and final WIDAR correlators has been delayed to the first quarter of CY08 and CY09, respectively. Currently, the delays have no schedule or budgetary impact on the EVLA project, but they do cause a delay in the wideband observing capability of the EVLA.

Monitor and Control

A critical design review of the EVLA Transition Monitor and Control (M&C) System was held on December 5–6, 2006. A transition system is needed to satisfy the project requirement that the VLA must continue to operate while the EVLA is being built. This means the transition system must be able to control EVLA and VLA antennas, the VLA correlator, and the prototype WIDAR correlator. The review

committee found that the requirements for the transition system are complete and that the architecture selected for the system design will satisfy those requirements. The committee's primary recommendations were to improve the design for network security, improve the design for system alerts, update the design of the virtual correlator interface (which has already been done), and make the use of the network protocol (UDP) for data transmission robust to packet loss.

The M&C hardware group has produced five F317 Front-End Utility Modules. Four were produced in December 2006. The modules have been tested and meet specification. The first F317 was installed on antenna 18, and it has been functioning properly with the new card cage for the past few weeks. One F317 permanently resides in the laboratory as a test unit. The other three F317 modules are ready for antennas 17, 23, and 26. The final design of the F317 is complete, and all parts and boards have been received to complete the construction of the remaining 70 modules. Starting in January 2007, two modules will be built per month. One module per month will go towards maintaining the EVLA outfitting schedule, and the other one will be used for retrofits in previously outfitted antennas.

Substantial progress was made over the last quarter toward the goal of retiring the old Modcomp-based VLA Control System. The hardware and software for the visibility pipeline were completed, providing a path by which the output of the VLA correlator is now available to the EVLA M&C System. The state of the interim version of the Data Capture and Format software was also advanced to the point where it is now possible to capture the output of the visibility pipeline and form a partial archive record containing visibility data and some, but not all, of the needed metadata. This partial archive record was successfully input to AIPS, demonstrating the complete data path from the antennas through the correlator to the post-processing software for the EVLA M&C System.

Another crucial milestone was a demonstration of the ability of the EVLA M&C System to control the VLA correlator. The VLA correlator was successfully operated in both continuum and spectral-line mode 1A by the EVLA M&C System.

Science Support Systems

The High Level Architecture effort continues to concentrate on the development of models for its various components. These models will be used by all subsystems of Science Support Systems. All major elements are implemented except for the description of the hardware setup, which is proceeding. The first application to use these models is the Observation Preparation Tool (OPT). The Observation Scheduling Tool (OST) will also soon be incorporating these models.

A third release of the VLA Proposal Submission Tool (PST) took place in September 2006, with a major change being the support of GBT proposals within the same tool. The tool was extremely well received, and only minor problems were encountered despite supporting the submission of 95 GBT and 123 VLA proposals, most of them in the final 24 hours before the deadline. The PST will be turned over to the new E2E Operations Division following the February 2007 deadline.

Work on the OPT continues. It now supports the definition of scans (all envisioned types) and the sources that populate them. Support will be implemented for the definition of the instrumental setup after it is implemented in the system-wide models.

1. Expanded Very Large Array

A new GUI tool was developed to manage catalogs of sources, including calibrator catalogs. This tool is also used for management of user catalogs and for selection of sources to be included in observation setups (via the OPT).

Work has begun on the OST, with the design fully fleshed out, and an initial implementation (based on the knowledge already gained from having a prototype in place for the VLA) is done. This will support current-style dynamic scheduling (with VLA OBSERVE files) and new-style dynamic scheduling (using Scheduling Blocks), and it also has built in a number of metrics to gauge performance.

The hardware and software for the ESO/ALMA Next Generation Archive System (NGAS) have been installed and are working. The system is being heavily tested. Potential exists for borrowing much of the ALMA archiving software for EVLA if we are able to re-use NGAS. The current VLA archive access web system was updated to allow automatic access to proprietary data for those projects that have used the PST for proposal submission. This is the first step toward a real "end-to-end" system where things are mostly automated.

NEW INITIATIVES

Square Kilometer Array (SKA)

Discussions in the U. S. have continued in order to define the revised work plan for the U.S. Technology Development Project (TDP) for the SKA. The NRAO is discussing commitments to lead Work Package 1, the Antennas, Feeds, and Receivers segment of this proposal, as well as Work Package 2.1, Signal and Data Processing. It is anticipated that the revised work plan will be submitted to the National Science Foundation (NSF) in the first quarter of 2007. Since the NRAO will not receive funding from the TDP, participation in these activities will require the appropriate allocation of personnel supported by the NRAO operations budget.

The U.S. SKA Consortium met in Cambridge, MA in November. A broad segment of the local scientific community was invited along with the Consortium members, with presentations emphasizing the broad scientific reach of the SKA. Following the official Consortium meeting, a face-to-face meeting was held with representatives of the International SKA Project Office and the leadership of the SKA development in Europe in order to discuss future collaboration and the international structure of the SKA.

The European radio-astronomy community plans to submit a proposal for SKA infrastructure and system development to the Seventh Framework Programme (FP7) funding opportunity within the European Community. NRAO attended the kickoff meeting in England and is participating in the development of this proposal, emphasizing the system-development portion that will request approximately half of the proposal funding. NRAO participation in the FP7 effort is planned to be predominantly via collaboration through the U.S. TDP effort. The FP7 proposal is expected to be submitted in the second quarter of 2007.

VLBI Space Observatory Programme-2 (VSOP-2)

The VSOP-2 mission was officially approved by the Japan Aerospace Exploration Agency JAXA earlier in 2006, with launch planned for February 2012. A kickoff meeting for development of VSOP-2 tracking stations was held at the Jet Propulsion Laboratory during the fourth quarter. NRAO attendees included representatives of the VLBA ground radio telescopes and of Green Bank, which developed and operated a tracking station for the original VSOP mission. Follow-up meetings aimed at more detailed technical development are planned for the first half of 2007.

VLBA Partnerships

The responsibility for development of partnerships for the VLBA was moved into the New Initiatives Office during the quarter. The report of the NSF Senior Review Panel was presented to the community and recommended that the NRAO find VLBA partnerships that would reduce the direct NSF cost of operating the VLBA to approximately half of its present value. The Senior Review report specifically mentioned the VSOP-2 mission, NASA, and the European VLBI community as potential partners. Discussions were held with each of these communities, and more, during the quarter. Development of concrete partnerships is anticipated to evolve throughout 2007.

2. New Initiatives

The Frequency Agile Solar Radio Telescope (FASR)

During this quarter, under NRAO leadership, the partners to the FASR consortium have worked to refine the operational, management, and governance models for the project. Further discussions are planned early in the upcoming quarter with the intention of establishing an organizational model and advancing the project toward the design and development stage.

GREEN BANK OPERATIONS

As the 2007 fiscal year began on October 1, we have modified the GBT's goals here to reflect the goals established in our 2007 Program Plan. Additionally, we have consolidated the goals to reflect the project, rather than the division in which work will be done. These goals will be tracked through FY2007.

GBT Site Milestones for FY2007

Milestones	Original Date	Revised Date	Date Completed
Azimuth Track Remediation[Note 1]			
1. Work Plan and schedule complete	10/01/06	10/10/06	10/10/06
2. First 24 wear and base plates manufactured	01/31/07	03/01/07	
3. Next 24 wear and plates manufactured	03/30/07		
4. All components on site	03/30/07		
5. Refurbishment starts	04/30/07		
6. Refurbishment complete	08/31/07		
7. Telescope performance restored	08/31/07		
Caltech Continuum Backend (CCB)			
1. Project Complete	10/01/06	01/26/07	
C-band Receiver Upgrade			
1. Upgrade Complete	02/15/07	07/31/07 [Note 2]	
2. Commissioning Complete	03/01/07	09/30/07 [Note 2]	
Dynamic Scheduling			
1. Test-Phase Complete	04/31/07		
2. Proposal Review	06/01/07		
3. Stage I tools complete, dynamic scheduling commences	02/01/08		
4. Stage II tools complete	02/01/09		
Ka-band Receiver			
1. Lab tests complete	10/15/06	10/10/06	10/10/06
2. Commissioning complete	11/31/06	12/14/06 [Note 3]	12/14/06
Q-band Receiver			
1. Lab tests complete	10/15/06	10/20/06	10/20/06
2. Commissioning complete	10/31/06	2/14/06 [Note 3]	12/14/06
Penn Array Receiver [Note 4]			
1. Document commissioning results	12/31/06	03/31/07	
PTCS			
1. Trajectory Generation and Servo Improvements complete	12/31/06	04/30/07	
2. PLC interlock system installed	08/31/07		
3. Small-scale surface errors characterized	08/31/07		
4. Laser rangefinder V2 development complete	09/31/07		
Spectrometer Long-Term Accumulator (LTA) Upgrade			
1. LTA design review	10/18/06		10/18/06
2. LTA upgrade complete	10/01/07		

OPERATIONS

1. Green Bank Operations

Milestones	Original Date	Revised Date	Date Completed
Zpectrometer Note 5			
1. Lab tests complete	09/30/06	10/29/06	10/29/06
2. Zpectrometer installed on telescope	10/01/06	10/30/06	10/30/06
3. Commissioning tests complete	12/01/06	12/01/06	12/01/06
Other			
1. GBT RFI Monitor Station Complete	09/01/06	12/31/06	
2. 140' MLLN tunable Receiver	08/18/06	11/30/06	11/30/06
3. GBT M&C Upgrade	08/31/07		

Notes:

1. The GBT Azimuth Track remediation project is proceeding well. At the end of the quarter, the studs and nuts have been delivered to the Green Bank site, the base plates and wear plates are in fabrication, and the field work plans and implementation schedules are in development.
2. C-band completion date moved to accommodate Penn Array work.
3. Q-band and Ka-band commissioning dates were moved back in an effort to limit the total commissioning time (and maintain astronomy time) on the GBT.
4. Penn Array Receiver progress has been slowed due to difficulties in fabricating the detector array.
5. Zpectrometer is in collaboration with Andy Harris at University of Maryland.

NEW MEXICO OPERATIONS

VLA and VLBA Milestones

Management and Scientific Milestones

Milestones	Original Date	Revised Date	Date Completed
1. VLA/VLBA Proposal and Large-Proposal Deadline	10/02/06		10/02/06
2. Host 22nd Annual New Mexico Symposium	10/06/06		10/06/06
3. Return EVLA antenna 26 to operational VLA	10/31/06		12/04/06
4. AIPS 31DEC06 Frozen; 31DEC07 Released	12/31/06		12/31/06
5. Decommission final tape drives on VLBA correlator	12/31/06	01/05/07	
6. Return EVLA antenna 23 to operational VLA	12/31/06	01/16/07	
7. VLA/VLBA Proposal Deadline	02/01/07		
8. Return EVLA antenna 17 to operational VLA	02/28/07	02/08/07	
9. Install lower-noise 22 GHz receiver at VLBA-PT	02/28/07		
10. Proposal Selection Committee w/ 5 outside members	04/04/07		
11. Return EVLA antenna 21 to operational VLA	04/15/07		
12. VLA/VLBA Proposal and Large Proposal Deadline	06/01/07		
13. Retire VLA Modcomp Computers	03/31/06	06/15/07	
14. First shared-risk science with EVLA 22 GHz tuning	04/30/07	12/31/07	
15. First shared-risk science with EVLA 1.2–2 GHz	12/31/07		
16. Complete 22 GHz low-noise retrofit of VLBA	12/31/07		

Notes:
13. This item was delayed into 2007 in order to enable personnel resources to be spent on EVLA monitor and control software development.
14,15. First 22 GHz science with wider tuning capabilities was deferred due to a lack of proposals for this capability with the relatively small number of EVLA antennas available. We anticipate the first science with wider-band tuning for 22 and 1.4 GHz will be proposed and accepted for the VLA B configuration in the last trimester of 2007.

Computer Infrastructure Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Bring up EVLA Antenna 23 Network	10/20/06		10/28/06
2. Assist with ALMA equipment move to ATF	10/20/06		11/17/06
3. Switchover to new AOC/VLA OC-3 link	12/01/06		11/20/06
4. Bring up EVLA Antenna 17 Network	12/20/06		12/12/06
5. Complete AOC network renumbering	12/15/06	01/15/07	
6. Bring up EVLA Antenna 21 Network	02/07/07		
7. Install new central Network Appliance file server	12/31/06	02/15/07	
8. Establish network tunnel to DRAO	08/31/06	03/31/07	

Milestones	Original Date	Revised Date	Date Completed
9. Establish network tunnel to ESO	09/30/06	03/31/07	
10. Conduct requirements survey for calendaring	08/01/06	12/31/07	Cancelled

Notes:
7. Order delayed, obtaining quotes, expect delivery mid-January
8. Requires further cooperation from DRAO and ESO
9. Requires further cooperation from DRAO and ESO
10. Canceled within CCE

Operations Software Support Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Correlator controller operational by EVLA monitor and control (Software Target Complete)	04/04/05	10/30/06	11/30/06
2. Transcribe VLA observe/system files	11/30/02	01/31/07	
3. Translate and copy stored VLA monitor data from 9-track to DAT (Digital Audio Tape)	03/01/04	06/30/07	

Notes:
2. , 3. Low priority

Electronics Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Develop a VLA RFI Plan	12/01/06		12/22/06
2. Install 17 MARK V playback units in Operations	01/05/07		
3. Remove all recorders from Socorro Operations	01/05/07		
4. Develop Plan for PT VLBA Maser #10	03/19/07		
5. Scheduled Maintenance Visit Ft Davis VLBA	05/07/07		
6. Complete VLA prototype antenna control unit (ACU)	07/20/07		
7. Scheduled Maintenance Visit Brewster VLBA	07/31/07		
8. Pickup refurbished Maser #13 from Sigma Tau	09/20/07		
9. Scheduled Maintenance Visit Owens Valley VLBA	09/26/07		
10. Disassemble analog Pie Town Link	09/28/07		
11. Revise White Sands RFI MOU	10/20/07		

Engineering Services Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Complete C-array re-configuration	10/20/06		10/18/06
2. Fort Davis VLBA Axle Repair	01/05/07		
3. Complete DnC-array reconfiguration	01/26/07		
4. Complete D-array reconfiguration	02/16/07		

5. Repair 3 intersections (AW6, AW5, BW9)	05/30/07		
6. Complete A-array reconfiguration	06/12/07		
7. Hancock VLBA Foundation and Subreflector Repair	07/30/07		
8. Complete BnA-array reconfiguration	09/21/07		
9. Complete B-array reconfiguration	10/12/07		
10. Replace 4,000 Ties	11/30/07		

NA ALMA SCIENCE CENTER

NAASC Milestones

Milestones	Original Date	Revised Date	Date Completed
1. NAASC Operations plan internal review	10/18/06		10/18/06
2. NAASC operations plan review by AUI/NRAO DO	10/26/06		10/28/06
3. AOP presentation to the ALMA Board in Madrid	11/09/06		11/09/06
4. Set up webpage for NAASC Protostellar Disks workshop	11/10/06		11/10/06
5. Submit NAASC proposal to NSF	10/27/06	10/31/06	10/31/06
6. Submit ALMA Operations plan to Board	10/11/06	10/31/06	11/03/06
7. ALMA Operations plan sent to external reviewers	01/31/07	02/08/07	
8. NSF panel ALMA site visit	01/26/07		
9. NSF Review of NAASC Plan	03/01/07		
10. International review of AOP at NSF headquarters	02/27/07		
11. ALMA external software testing—Pipeline	01/18/07	03/01/07	
12. ALMA external software testing—CASA	10/30/06	03/05/07	
13. 2nd NAASC workshop—Protostellar Disks	06/22/07		
14. Spectral-line catalogue—continue resolving species	Ongoing		
15. Spectral-line catalogue—organize working group, first meeting in Charlottesville, Spring 07	04/05/07		

CENTRAL DEVELOPMENT LAB

Amplifier Design and Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Evaluation of TRW Cryo-3 devices to determine noise, signal, and dc properties at cryogenic temperatures	04/01/04	ongoing	
2. Design/redesign of cryogenic amplifiers using Cryo-3 TRW devices for EVLA, VLBA, GBT, and ALMA in the frequency range from 1 to 120 GHz	04/01/04	ongoing	

Notes:
2. Redesign of the 18–26 GHz and 26–40 GHz amplifiers for the EVLA was completed. That completes the original task of design and development of all EVLA amplifiers covering the 1–50 GHz frequency range. The development of demonstration amplifiers for ALMA band 1 and band 2 receivers is in progress.

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

Amplifier Production Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Build/upgrade/repair cryogenic amplifiers using Cryo-3 TRW devices for EVLA covering frequency range from 1 to 50 GHz	12/31/15		Ongoing activity
2. Build/upgrade/repair cryogenic amplifiers using Cryo-3 TRW devices for VLBA, GBT covering frequency range from 1 to 95 GHz	ongoing		Ongoing activity
3. New amplifier test-system development	06/30/06	6/30/07	

Notes:
1 and 2. Second-quarter production totaled 21 new and upgraded amplifiers, including L (1–2 GHz), C (4–8 GHz), K (18–26 GHz), and Q (40–50 GHz) band units primarily for EVLA receivers.
3. The PC/LabVIEW-based noise-measurement system is operational, producing measured data identical to the old ADIOS system, verifying calibration continuity between the NRAO-built and commercial hardware. Three systems in roll-around carts have been completed, with recent software additions allowing the capture of analog data in conjunction with HPIB (IEEE-488) instrumentation. An inexpensive piece of commercial software ("Painless Extraction") was added, allowing the 8510 Network Analyzers to transfer data directly to PCs for storage and printing. Testing and software refinements will continue.

Other Projects:
The Chemistry Lab plated approximately 50 grams of gold in support of ALMA construction, amplifier production, and various GBT projects. That represents a gold value of about $1,000 and an estimated job cost of $15,000 if done commercially. A new alkali-copper process has been added, aiding in the production of high-quality electroformed components. A number of complex electroform pieces have now been completed with excellent results.

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	04/01/07	
2. Develop integrated wideband LNA/feed package	12/01/06	04/01/07	
3. Evaluate Adaptive Digital Image-Rejection approach for wideband downconversion	12/01/06	01/01/08	
4. Test the revised DSN wideband downconverter	01/01/07	04/01/07	
5. Design wideband downconverter module for the Allen Telescope Array	03/01/07		
6. Package and measure wideband 11–34 GHz LNA	03/01/07		
7. Design and test GaAs W-Band power amplifiers to improve reliability of millimeter-wave local oscillators	03/01/07	04/01/08	
8. Development of wideband low phase noise MMIC VCOs	10/1/07		
9. Millimeter/Sub-millimeter HBT MMIC development	10/1/07		

Notes:
1. Extensive effort has been put into designing this MMIC. Some progress has been made, but the combination of specifications on input impedance, noise temperature, and dynamic range are proving to be most challenging. A serious design will have to wait for the appropriate MMIC wafer run.
2. New insights into the high-order behavior of ultra-wideband mixers have made this approach less desirable than originally thought for decade-bandwidth systems. We still intend to explore it for other applications, but its priority has been reduced.
3. This task has been delayed by an error in fabrication at the foundry.
4. The design for a new GaAs power amp for ALMA Band 3 (up to 108 GHz) has been completed and is in fabrication. The 70 nm GaAs wafer run has been delayed in order to reduce cost by sharing space with BAE's IRAD (Internal Research and Development) program.
8. Collaboration is continuing with Dr. Chiong from the ASIAA institute in Taiwan, who was at the NRAO for a 12-month visiting appointment. The MMIC VCOs designed by Dr. Chiong during his stay at the NRAO were fabricated and samples were delivered to the NRAO for on-wafer testing. Figure 1 shows a photograph of a MMIC VCO with a 14.5–18.2 GHz measured on-wafer tuning bandwidth. This covers the band required for the ALMA band 10 LO driver. Using this MMIC VCO, an all-MMIC LO driver has been designed to fit into a 0.75" x 0.90" x 1.03" package containing the VCO, warm multipliers, amplifiers, mixers, and filters needed to drive the cold frequency multipliers for band 10. The drawing of the inside of this module design is shown in Figure 2.

Other Projects:
As part of the development of ALMA local oscillators for band 10, we have investigated more closely the generation, propagation, and effects of local-oscillator sideband noise on single-ended mixers, both double sideband and sideband-separating. A paper on this research will be presented at the 18th International Symposium on Space Terahertz Technology entitled "Maximizing Signal-to-Noise Ratio in Local Oscillator Chains for Sideband-Separating Single-Ended Mixers". A high-school intern assisted with some of the signal-to-noise measurements in this paper. This theory will help considerably with the design of the band 10 local oscillator, which will need to pump a sideband-separating mixer after large

multiplication factors. The work analyzes the PM (phase modulation) noise, which is suppressed in a double sideband (DSB) mixer, but can still add considerable noise to a sideband-separating (2SB) mixer.

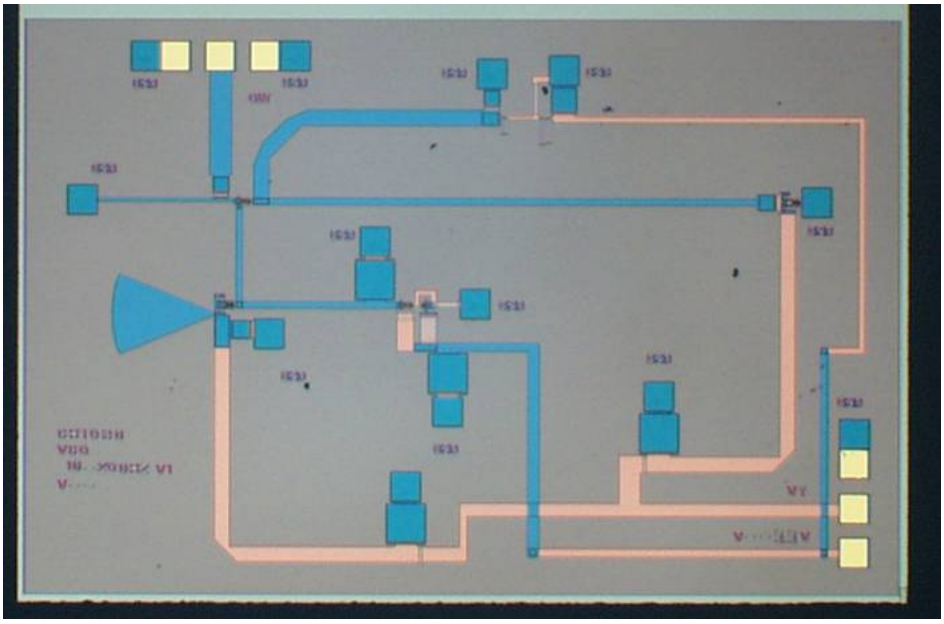

Figure 1. Photograph of MMIC 14.5–18.2 GHz VCO suitable for an ALMA band 10 local-oscillator source.

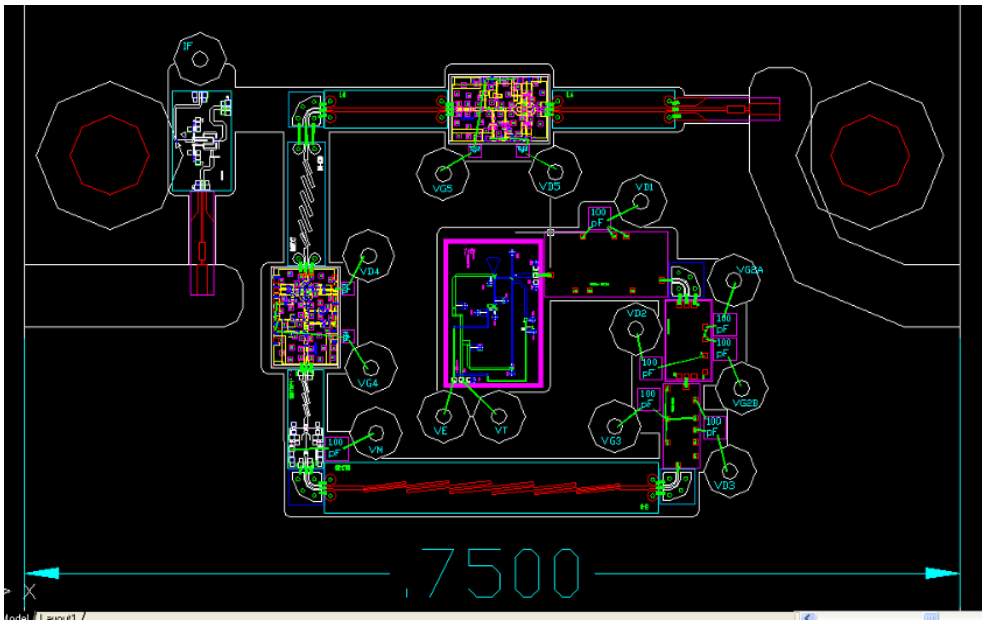

Figure 2. Drawing of the inside of a designed multi-chip module (MCM) for an ALMA band 10 local-oscillator driver. The dimensions of the module are 0.90" x 0.75" x 1.03".

4. Central Development Lab

Superconducting Millimeter-Wave Receiver Development Milestones

Milestones	Original Date	Revised Date	Date Completed
350-µm Receiver Technology Development			
1. Demonstrate NbTiN/insulator/Nb tunnel junction	10/01/06	03/01/07	
Balanced SIS Mixer Development			
2. Complete first balanced SIS mixer with superconducting IF hybrid	01/01/07	07/01/07	
3. Complete first balanced sideband-separating mixer	10/01/07	03/01/08	
Other Mixer Development			
4. 385–500 GHz SIS mixer Development	09/30/05	12/31/07	
5. Measure IF characteristics of a diffusion-cooled HEB mixer	06/30/06		

Notes:
1. This project is being done with the University of Virginia Microfabrication Laboratory. The withdrawal of promised funding from the University of Arizona will delay the fabrication and testing of RF structures using NbTiN SIS junctions.
3. This project is the next step towards the ultimate low-noise SIS receiver. It builds on 2, above, to make a balanced sideband-separating SIS mixer with very low noise and low LO power requirement. Such mixers will be essential for future coherent mm/sub-mm focal-plane and beam-forming array receivers.
4. This project is on hold awaiting funds and engineering resources.

Electromagnetic Support Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Design of EVLA 12–18 GHz feed	09/30/04	06/30/07	
2. Develop dual band 345/800 MHz feed for the GBT	09/30/05	09/30/07	
3. Measure EVLA 2–4 GHz feed	03/31/07	06/30/07	
4. Prototype, fabricate and measure a W-band phase shifter at K band	03/31/07	09/30/07	

Notes:
2. The gain/system temperature of the dual-band feed varied between 0.5 and 1 compared to the single-band feed at 345 MHz and between 0.55 and 0.73 at 800 MHz. Further work is required to improve the performance of the dual-band feed.
3. The circular to square transitions required for testing the feed are to be designed and fabricated.
4. A prototype of the phase shifter at K band was fabricated and measured. The differential phase shift is only about 60 degrees and the discrepancy will be investigated.

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	
2. 80–300 MHz, dual polarization, log-periodic on 45-foot telescope, new digital spectrometer	09/30/05	11/05/06	
3. 300–2500 MHz, dual polarization, 45-foot telescope with log-periodic feed, new digital spectrometer	09/30/05	11/05/06	

Notes: The low-frequency antenna work has been delayed until spring 2007.

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

Milestones	Original Date	Revised Date	Date Completed
1. Major upgrade to instrumentation subsystems	07/15/07		
2. 16-element prototype array, operating in the 100–200 MHz band in Green Bank	12/31/06	09/30/07	
3. 32-element array in Western Australia	12/15/06	12/31/07	

Notes:

3. The size of the Western Australia array has been increased to 32 elements. Deployment has been rescheduled for December 2007.

Frequency-Agile Solar Radiotelescope (FASR) Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Reference Instrument including engineering design document	06/16/06	04/15/07	

CHILE OPERATIONS

Local Labor Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Benefits Package was implemented for Local Staff	10/01/06		10/01/06
2. Internal Regulations document ready for submittal to employees and local authorities			12/01/06
3. Medical benefits negotiation with AURA and Carnegie completed. Offer submitted.			11/01/06
4. Hiring of NRAO Chile business staff.			12/01/06

Notes:
2. Submitted to employees in December, to authorities on 2/2/07.
4. Project specialist, senior and assistant accountants.

Business/Contracting Milestones

Milestones	Original Date	Revised Date	Date Completed
1. ALMA Contractors Camp Enlargement	1/12/07		12/20/06
2. Vertex Site Erection Facility construction starts	11/14/06		11/14/06
3. AOS Technical Building electrical/mechanical purchase completed	Sep to Nov/06		Nov/06
4. ALMA Camp extension, stage 2—bid process	8/25/06	12/20/06	12/20/06
5. Internal procurement & contracts audit of the Chile office			12/07/06
6. First external KPMG audit of the Chile office			12/15/06

Notes:
1. Work completed before schedule.
2. AUI awarded contract to Ocegtel
3. Procurement done by AUI to save overhead costs from Contractors, savings of U.S.$ 320k obtained to date: HVAC, Control systems, Fire detection and extinguishing systems, Oxygen enrichment, compressors and Ozone generators, UPS, Sewage water holding tank, Windows, Doors, Raised floor, Boiler, Heating system for water tanks, Suspended ceiling.
4. The first bid was declared void, not meeting ALMA's expectations. A second bid process was conducted and finished by Dec. 06.

Other Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Environmental reporting to CONAMA[1]	Monthly		Monthly
2. Site protection (Mining rights payment)	11/24/06		11/24/06
3. Water treatment plant enlargement			12/15/06

Notes:
1. Monthly reports are sent to CONAMA; in its latest site visit CONAMA congratulated ALMA for its environmental management performance.
2. On November 24th ended mining rights obtained in year 2005. Site protection was maintained by renewing mining rights.
3. On December 15th plant enlargement started up.

E2E OPERATIONS

e2e Management & Administration Activities

Milestones	Original Date	Revised Date	Date Completed
1. Strategic alliances for external funding established	09/30/06		09/30/06
2. External funding plan established	09/30/06		09/30/06
3. Social-network analysis early results disseminated	12/31/06	*deferred*	*indefinitely*
4. Proposals for external funding developed and issued	12/31/06		12/06/06
5. Prepare proposal for computational science REUs	04/30/07		
6. Oversight for March 2006 external CASA tests	03/09/07		

NRAO Participation in the National Virtual Observatory (NVO) Project

Milestones	Original Date	Revised Date	Date Completed
1. Draft SSA 1.0 data model (Spectrum) document	10/12/06	deferred	
2. Scalable data analysis framework BoF at ADASS	10/16/06		10/06/06
3. NVO fall team meeting (Annapolis)	11/09/06		11/09/06
4. VOClient enhancements including SSA support	12/01/06		12/31/06
5. Draft chapters for NVO end-of-grant-period book	12/01/06		12/01/06
6. Promote Cone Search to PR (prelim. recommendation)	12/01/06		12/31/06
7. Promote Simple Image Access to PR	12/01/06		12/31/06
8. Promote Simple Spectral Access to PR	12/15/06		12/31/06
9. Promote Line Access Protocol to PR	12/15/06		12/31/06
10. Contribute pre-proposals to NVO facility proposal	11/20/06		11/20/06
11. Contribute draft proposal input to NVO facility proposal	12/31/06		11/20/06
12. Conduct Fall 2006 joint meeting of NRAO/NVO	12/31/06		
13. Scalable data analysis framework functional prototype	02/15/07		
14. Initial working draft SIA V2 document	05/01/07		
15. Initial working draft table access protocol document	05/01/07		
16. Concept for handling SEDs and spectral aggregates	05/01/07		
17. IVOA interoperability meeting (China)	05/14/07		

6. e2e Operations

NRAO Archive Infrastructure & Interfaces

Milestones	Original Date	Revised Date	Date Completed
1. Acquire and install ESO/NGAS Archive Software	01/15/06		09/30/06
2. Integrate NGAS archive system into existing NRAO science data archive	09/30/06		09/30/06
3. Document role of archive facilities in the NRAO Integrated Science Center vision, including envisioned physical and application architectures	09/30/06	02/28/07	
4. Updates to SIAP image server	11/15/06	10/31/06	12/31/06
5. Complete VO-Google Pre-prototype	12/31/06	01/31/07	
6. Complete VO-Google Beta	04/15/07		
7. Devise archive-index schema and replication scheme; resolve data integrity issues in current NRAO archive	04/30/07		
8. Determine release date for Archive v2.0	03/15/07		
9. Complete transfer of historical VLBA tape archive	12/31/06	12/31/07	
10. Complete transfer of 1.5 TByte historical GBT science data	12/31/06	12/31/07	
11. Complete transfer of Tucson 12 m telescope data	12/31/07		
12. Complete transfer of Green Bank 140 ft telescope data	12/31/07		

NRAO Proposal Infrastructure & Interfaces

Milestones	Original Date	Revised Date	Date Completed
1. Develop transition plan	09/30/06	11/15/06	11/15/06
2. Effect transition of NRAO PST & Database to e2e Ops	12/31/06	02/15/07	
3. Complete PST performance improvements	05/20/07		
4. Successful maintenance of PST in first e2e-managed proposal deadline period	06/01/07		

Scheduling & Metrics Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Develop coordination calendar for scheduling efforts across Observatory	12/31/06		10/31/06

Data Processing (CASA/GBTIDL) Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Integrate CASA/GBTIDL milestones into upcoming quarterly reports	09/30/06	12/31/06	

6. e2e Operations

NRAO Pipeline Infrastructure & Interfaces

Milestones	Original Date	Revised Date	Date Completed
1. Summary statistics and report on existing VLA/VLBA pipeline in AIPS	09/30/06	11/15/06	
2. First half of VLA archive processed via pipeline	06/30/07		
3. Requirements for pipeline improvements set	09/30/07		
4. Second half of VLA archive processed via pipeline	06/30/08		
5. Develop plan for common VLA/Chandra sources	12/31/06		
6. Explore possibility of common NRAO/HST sources	12/31/06		
7. Explore possibility of common NRAO/Spitzer sources	12/31/06		
8. Process in place for a data analyst to pipeline and archive straightforward VLA/VLBA observations within two weeks of data availability	01/31/07		
9. Feedback from researchers regarding utility of pipelined products available and disseminated	06/30/07		

COMPUTER AND INFORMATION SERVICES

Observatory-wide Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Upgrade link between UVa and NRAO-CV to 100 Mbps (d)	10/31/06		10/25/06
2. Investigate network monitoring software (d)	10/31/06		10/31/06
3. Acquire and deploy network monitoring software (d)	12/31/06		11/15/06
4. Switch over to new AOC/VLA OC-3 link (d)	11/30/06		11/21/06
5. Final version of data security policy (a)	12/31/06		11/30/06
6. Authenticated outgoing mail (SMTP) (b)	11/30/06	12/31/06	12/31/06
7. Deployment of Symantec Anti-virus version 10 (a, b)	07/31/06	12/31/06	12/31/06
8. Complete computer inventory facility (b)	12/31/06		12/31/06
9. Upgrade link between UVa and NRAO-CV to 1 Gbps[1] (d)	01/31/07	04/30/07	
10. Formal approval of data security policy (a)	02/28/07		

Notes:

1. This will be installed by UVa as soon as the requisite components are available.

(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 service-interruption notification utility	01/15/07		
2. Upgrade Exchange Server	03/31/07		

EDUCATION AND PUBLIC OUTREACH

Publications Milestones

Milestones	Original Date	Revised Date	Date Completed
1. General public brochure delivered by printer to NRAO	05/26/06	11/5/06	12/13/06
2. Announce 2nd annual AUI/NRAO Image Contest winners	10/13/06		10/05/06
3. Issue submission call for January Newsletter	11/01/06		11/01/06
4. January Newsletter delivered to printer	12/15/06		12/20/06
5. Initiate 2007 NRAO Calendar design	11/10/06		11/10/06
6. 2007 NRAO Calendar delivered by printer	12/22/06		12/27/06
7. Select images for two new large-format posters	11/11/06		11/10/06
8. Printer delivers posters	12/22/06		12/27/06
9. Announce 3rd annual AUI/NRAO Image Contest	01/10/07		
10. 3rd annual AUI/NRAO Image Contest website on-line	02/14/07		
11. Issue submission call for April Newsletter	03/01/07		
12. Select images for two new large-format posters	03/09/07		
13. April Newsletter delivered to printer	03/20/07		
14. Deliver two new posters to printer	04/13/07		
15. Printer delivers posters	05/04/07		
16. 3rd annual AUI/NRAO Image Contest deadline	09/07/07		

Notes:

1. This new brochure is proving popular. This first print run was 10,000 copies. A second print run will likely be needed in spring 2007.

4. The print run for the January 2007 NRAO Newsletter was 10,000 copies so that a copy could be delivered to every AAS individual and institutional member, in addition to the existing subscribers.

6. Three thousand copies of the 2007 NRAO Calendar were printed.

7. EPO Scientist Juan Uson's Messier 51 (Whirlpool Galaxy) radio-optical image composite, and Jayanne English's First Prize radio-infrared composite image from the 2006 AUI/NRAO Radio Astronomy Image Contest, were selected for the NRAO poster series. The print run for each poster was 3,000 copies.

9. The 3rd annual AUI/ NRAO Image Contest implements the recommendation of the 2006 Image Contest judges that the contest include a Third Prize.

World Wide Web Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Advertise for WWW positions	10/06		10/15/06
2. EPO WWW Content Specialist selection	12/15/06	06/01/07	

8. Education and Public Outreach

Notes:
2. A disappointing candidate pool will require a second advertising campaign and delay this hire into spring 2007. A contractor will be hired to perform the EPO web-site design work that this position would have otherwise initiated this winter.

ALMA EPO Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Complete Sister Cities MOU	11/17/06		11/17/06
2. Complete ALMA brochure (English, Spanish)	11/08/06		11/02/06
3. ALMA EPO WG face-to-face meeting (Madrid)	11/16/06		11/16/06
4. Update ALMA brochure for interferometry school (Chile)	12/01/06		12/01/06
5. Update ALMA brochure for AAS meeting (Seattle)	12/08/06		12/22/06
6. ALMA EPO WG reviews 1st draft Global ALMA EPO Plan	01/18/07		
7. Sister Cities Program: Magdalena, NM	01/28-02/09/07		
8. ALMA EPO WG reviews 2nd draft Global ALMA EPO Plan	02/22/07		
9. EPO briefing for international ALMA Operations review	02/27/07		
10. EPO briefing for NA ALMA Operations review	03/01/07		
11. ALMA EPO WG reviews 3rd draft Global ALMA EPO Plan	03/08/07		
12. Submit rev 1.0 Global ALMA EPO Plan to ALMA Board	03/15/07		
13. Submit rev 1.0 ALMA EPO Policies & Procedures to ALMA Board	03/15/07		
14. ALMA Board presentation re EPO	03/28/07		
15. Sister Cities Program: San Pedro de Atacama, Chile	06/25-07/06/07		

Notes:
5. NRAO is leading the generation of the Global ALMA EPO Plan.
12. ESO is leading the preparation of the ALMA EPO Policies & Procedures.
13. ALMA Director Massimo Tarenghi will give the EPO presentation to the ALMA Board at their March 2007 meeting in Japan.
15. Owing to the success of the Jan – Feb 2007 New Mexico program, the Magdalena school district is sponsoring another teacher to participate in the educational and cultural exchange with San Pedro de Atacama, Chile, in addition to the two teachers who are participating via AUI sponsorship. Thus, three teachers from the Magdalena, NM school district will visit San Pedro de Atacama in late June and early July 2007.

8. Education and Public Outreach

Astronomical Community Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Complete NRAO exhibits revision	12/15/06		12/22/06
2. Ship exhibits/materials to winter AAS meeting	12/27/06		12/28/06
3. NRAO Town Hall at winter AAS meeting	01/08/07		
4. Winter AAS meeting / exhibition ends	01/10/07		
5. Ship exhibits / materials to summer AAS meeting	05/18/07		
6. Summer AAS meeting / exhibition	05/27-31/07		

Notes:
5, 6. The summer AAS meeting is in Honolulu, HI.

Community Relations & Management EPO Milestones

Milestones	Original Date	Revised Date	Date Completed
1. NM Tech Skeen Library public talk (Socorro, NM)	10/05/06		10/05/06
2. Johns Hopkins Univ Ctr for Talented Youth (UVa) talk	10/21/06		10/21/06
3. VA Piedmont Tech Tour (NTC)	10/26/06		10/26/06
4. 2006 NRAO CV Open House	11/05/06		11/05/06
5. Submit Pulsar Search Collaboratory project preliminary proposal to NSF	01/05/07		
6. Royal Astronomical Society - Victoria Centre talk	01/10/07		
7. Hertzberg Institute of Astrophysics talk	01/10/07		
8. Royal Astronomical Society - Okanagan Centre talk	01/11/07		
9. DRAO - Penticton talk	01/12/07		
10. GB Science Center marketing panel review	02/09/07		
11. Virginia Piedmont Regional Science Fair	03/08/07		
12. Shenandoah Valley Stargazers talk	03/16/07		
13. ASP EPO meeting (Chicago)	09/05-07/07		
14. Communicating Astronomy to the Public (Athens)	10/07-11/07		
15. Green Bank Community Open House	10/21/07		

Notes:
6, 8, 11. "Three Radio Astronomy Futures: ALMA, EVLA, SKA" by Adams.
7, 9. "Communicating the NRAO Mission and Science" by Adams.
10. AUI/NRAO is sponsoring the Physics & Astronomy category for this regional science fair. Several NRAO EPO and scientific staff have volunteered to be judges.
13. Sponsored by IAU Commission 55, this meeting will define the International Year of Astronomy – 2009 program for the IAU.

8. Education and Public Outreach

Custom School & Civic Group Program Milestones

Milestones	Original Date
1. Marshall University (GBT)	10/06/06
2. Boy Scout Troop #225 (GBT)	10/07/06
3. North Carolina State University (GBT)	10/12/06
4. Boy Scout Troop 22 (GBT)	10/13–14/06
5. Lynchburg College (GBT)	10/19/06
6. FSC (GBT)	10/21/06
7. Trinity Area School District (GBT)	10/27–28/06
8. West Stanley High School (GBT)	11/16–19/06
9. Bethany College (VLA)	01/17/07
10. Boy Scout Troop 117 (GBT)	01/20/07
11. University of New Mexico (VLA)	02/09/07
12. Clarksburg Scout Group (GBT)	02/10/07
13. Fox Chapel (GBT)	02/17/07
14. Engineering Week student group (VLA)	02/18/07
15. University of New Mexico (VLA)	02/18/07
16. Science Olympics, San Jon Schools (VLA)	02/22/07
17. West Stanley High School (GBT)	02/22–24/07
18. Providence Day School (GBT)	03/01–04/07
19. Colorado Spring School (VLA)	03/06/07
20. Pomona College (VLA)	03/09/07
21. Villanova Astronomical Society (GBT)	03/16–17/07
22. Lynchburg College (GBT)	03/22/07
23. Gallop Junior High School (VLA)	03/22/07
24. Linwood Holton Governor's School (GBT)	03/23–24/07
25. Morehead University (GBT)	03/30/07
26. IEEE (VLA)	03/30/07
27. Easton Area High School (GBT)	03/31–04/01/07

Education & Conference Program Milestones

Milestones	Original Date
1. Science Bowl 2006	11/02/06
2. Chautauqua 2007	06/03-08/07
3. Education Research in Radio Astronomy	06/10-16/07
4. National Youth Science Camp staff training	06/17-21/07
5. Green Bank StarQuest IV	07/04-07/07

8. Education and Public Outreach

Milestones	Original Date
6. NASA/NRAO Joint Teacher's Institute	07/15-20/07
7. GLOBE Teacher Workshop	07/22-27/07
8. 3rd Annual Governor's School for Math & Science	07/29-08/11/07

ADMINISTRATION

Environment, Safety, and Security (ES&S)

On the ALMA Project, ES&S participated in the ATF (Antenna Test Facility) training program to assure safety at the ATF in New Mexico. In New Mexico, ES&S drafted a Scope of Work for the completion of a site-wide asbestos survey, and the Emergency Services group conducted training sessions for certification of additional First Responders. In Green Bank, the site safety inspection was completed and a new 300 gallon waste oil tank is expected to be installed in February 2007. The pandemic response (Bird Flu) program was drafted and distributed for comment. In Charlottesville, significant progress was achieved with the installation of the NTC fire detection and alarm systems as well as the card access system.

ALMA

Work on the ALMA project included several design reviews including the completion of the Vertex antenna pre-production design review, the Alma Compact Array correlator, the ALMA site power and signal vaults, and the Band 7 Safety Documentation review. Work included the safety acceptance of the Back End Dummy Racks for shipment. At the antenna test facility in New Mexico, ES&S participated in the AEM training program and provided specific safety sessions to allow authorized persons to access the antennas safely. These sessions establish the minimum requirements to assure safe operation and maintenance of the prototype antennas. Additional safety documentation included the update of the Conditions Rules and Regulations for Construction and the annual review of the ALMA Safety Manual was also completed.

NRAO-New Mexico

In New Mexico, ES&S drafted a Scope of Work for the completion of a site-wide asbestos survey for the VLA. The formal U.S. Department of Transportation drug and alcohol testing program manual was drafted and the review initiated. This quarter, the Emergency Services group conducted training sessions for certification of additional First Responders. At the AOC, the means of egress have been appropriately signed and illuminated; however, the AOC floor striping is still pending and planned for the first quarter 2007. This quarter, the AOC X-ray machine written program was posted on the ES&S safety pages. At the VLA, the procurement of a new waste-oil storage tank was initiated with installation planned for the first quarter of 2007. The identification of waste streams for hazardous waste materials at the AOC was completed and a summary of the waste streams was developed. The information provides contact numbers, as well as estimates on the quantity of waste generated from the AOC. Lastly, the Emergency Medical Services radio system and antenna have been installed at the VLA.

NRAO-Green Bank

In Green Bank, lightning again knocked out the fire-alarm panels in the Warehouse and Works Area. There was one spare board in stock and an additional replacement is pending. At the Science Center, the fire-alarm system continues to be non-operational; however, GB management has dedicated staff support to correct the problem. This quarter, the Green Bank site safety inspection was completed and most of the items identified have already been corrected. A waste-oil storage tank has been scheduled for replacement and a new 300 gallon double-walled steel tank is on order and is expected to be installed in February

2007. The pandemic response (Bird Flu) program was drafted and distributed for comment, and the Safety Eyewear Policy was updated to reflect an increase in benefits for the users of protective eyewear.

NRAO-Charlottesville

This quarter, significant progress was achieved with the installation of the NTC fire-detection and alarm systems as well as the card access system. The fire-detection and alarm system will connect to the existing fire-detection and suppression system for the ALMA correlator. Final testing and acceptance of the completed systems is anticipated next quarter. In conjunction with the project, an alarm protocol and evacuation plan was developed with the correlator group. At Edgemont Road, the heating-pipe replacement project required asbestos removal that was monitored by the University of Virginia responsible group.

Future Efforts

In the next quarter, the site safety representatives will pursue the development of the GBT fire suppression system with Green Bank staff, will complete the implementation of the pandemic response program, and will complete a comprehensive site safety inspection in Charlottesville.

PROGRAM MANAGEMENT OFFICE

Contractor work on the Web-Based Business Services (WBBS) was essentially completed during this quarter. With the conclusion of the development and implementation phase of the WBBS project, responsibility for WBBS was transferred from the Program Management Office (PMO) to the Administration group, as planned. The Management Information Services group also transferred from PMO to Administration in support of the WBBS transition. An additional staff member, B. Dorpinghaus, was added to the MIS group to help meet the new responsibilities.

PERSONNEL

NEW HIRES

Aeree Chung	Jansky Fellow	10/09/06	
Buckner Creel	Junior Fellow	11/01/06	
Todd Hunter	Associate Scientist/A	11/01/06	
Juergen Ott	Jansky Fellow	12/01/06	
Jeffrey Wagg	Post Doc	12/18/06	

TERMINATIONS

John Payne	Scientist/RE	12/31/06	Retirement
Barry Turner	Astronomer	09/30/06	Retirement
Qi Feng Yin	Scientist/A	09/30/06	Retirement

PROMOTIONS

Amy Shepherd	Budget Manager	12/01/06	

TRANSFERS

Dana Balser	e2e Scientist	10/01/06	GB to CV

BUDGET

The table below represents NRAO Operations (without EVLA) expenses and commitments for Quarter 1 of Fiscal Year 2007 as reported at Work Breakdown Structure (WBS) Level 1.

The available funds for NRAO Operations (without EVLA) total $55,622k. This amount includes $44,905k in new NSF Funds ($50,740k less $5,835k for EVLA Phase 1 construction), $5,299.8k in prior-year commitments, $5,417.2k in prior-year operations carryover. A total of $12,685k in new NSF funds for NRAO Operations has been received.

NRAO Operations Expenses and Commitments FY 2007
Year to Date (October 1, 2006 to December 31, 2006)

Work Breakdown Structure Element Level 1	Salaries & Benefits	Materials & Services	Travel	Revenue or Cost Recovery	Total
Observatory Management	$1,034,230	$513,863	$62,437	-$38,783	$1,571,746
Education and Public Outreach	$126,489	$53,962	$6,448	-$33,949	$152,950
Central Development Lab	$323,742	$125,332	$2,914	-$63,235	$388,753
Green Bank Operations	$2,016,915	$719,460	$29,413	-$120,568	$2,645,220
New Mexico Operations	$3,129,811	$1,290,850	$70,886	-$26,544	$4,465,002
ALMA Operations	$210,387	$61,756	$15,670	$0	$287,814
Computer and Information Services	$211,925	$119,260	$1,041	$0	$332,226
Division of Science and Academic Affairs	$456,512	$368,108	$67,885	$0	$892,505
	$7,510,010	$3,252,590	$256,693	($283,079)	$10,736,215

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
AAS	American Astronomical Society
ACU	Antenna Control Unit
ADASS	Astronomical Data Analysis Software and Systems (meetings)
ADIOS	Analog Digital Input Output System
AEM	consortium manufacturing the European ALMA antennas
AGN	Active Galactic Nucleus, or Active Galactic Nuclei
AIPS	Astronomical Image Processing System
ALMA	Atacama Large Millimeter Array
ANASAC	ALMA North American Scientific Advisory Committee
AOC	Array Operations Center (Socorro, NM)
AOP	Array Operations Plan
AOS	Array Operations Site (ALMA)
ARC	ALMA Regional Center
ASAC	ALMA Scientific Advisory Committee
ASP	Astronomical Society of the Pacific
ATF	Antenna Test Facility (ALMA)
AUI	Associated Universities, Incorporated
AURA	Association of Universities for Research in Astronomy
BAE	British Aerospace Engineering
BoF	Birds of a Feather (special meetings within ADASS)
C-band	4–8 GHz
CASA	Common Astronomy Software Applications
CCB	Caltech Continuum Backend (GBT)
CCE	Common Computing Environment
CDL	Central Development Laboratory (Charlottesville, VA)
CDR	Critical Design Review
CIS	Computer and Information Services
CONAMA	Chilean National Environmental Commission
CV	Charlottesville
CY	Calendar Year
DAT	Digital Audio Tape
DRAO	Dominion Radio Astrophysical Observatory
DSAA	Division of Science and Academic Affairs
DSN	Deep-Space Network (NASA)
DTS	Digital Transmission System
e2e	End-to-End
EPO	Education and Public Outreach
ES&S	Environment, Safety, and Security (NRAO)
ESO	European Southern Observatory
EVLA	Expanded Very Large Array
eVLBA	Electronic (real time) Very Long Baseline Array
F317	Front-end utility module (EVLA)
FASR	Frequency-Agile Solar Radiotelescope
FM200	Fire-suppression system
FY	Fiscal Year

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
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
GRB	Gamma-Ray Burst
Gsps	Giga samples per second
GUI	Graphical User Interface
HBT	Heterostructure Bipolar Transistor
HEB	Hot-Electron Bolometer
HI	Neutral hydrogen
HSA	High Sensitivity Array
HST	Hubble Space Telescope
HVAC	Heating, Ventilation, and Air Conditioning
IAU	International Astronomical Union
IDL	Interactive Data Language
IF	Intermediate Frequency
IR	Infrared
IVOA	International Virtual Observatory Alliance
JAO	Joint ALMA Office
JAXA	Japan Aerospace Exploration Agency
JPL	Jet Propulsion Laboratory
K	Kelvins (temperature)
K-band	18–26.5 GHz
Ka-band	26.5–40 GHz
KPMG	Auditing firm
Ku-band	12–18 GHz
L-band	1–2 GHz
LNA	Low-Noise Amplifier
LO	Local Oscillator
LTA	Long-Term Accumulator (GBT spectrometer)
M&C	Monitor and Control
Mbps	Mega bits per second
MHz	Megahertz
MK	Mauna Kea (VLBA station)
MLLN	MIT–Lincoln Labs–NRAO
Mm	Millimeter
MMIC	Monolithic Microwave Integrated Circuit
MOU	Memorandum of Understanding
NA	North American / Not Applicable / Not Available
NAASC	North American ALMA Science Center
NAOJ	National Astronomical Observatory of Japan
NASA	National Aeronautics and Space Administration

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
Nb	Niobium
NbTiN	Niobium Titanium Nitride
NGAS	Next Generation Archive System
NRAO	National Radio Astronomy Observatory
NSF	National Science Foundation
NTC	NRAO Technology Center (Charlottesville)
NVO	National Virtual Observatory
OC-3	155 Mbps Optical Carrier link
OMT	Orthomode Transducer
OPT	Observation Preparation Tool
OST	Observation Scheduling Tool
P-band	327 MHz
PAPER	Precision Aray to Probe the Epoch of Reionization
PC	Personal Computer
PEP	Performance Evaluation Process
PLC	Programmable Logic Controller
PR	Preliminary Recommendation (status)
PST	Proposal Submission Tool
PT	Pie Town (VLBA station)
PTCS	Precision Telescope Control System
Q	Quarter
Q-band	40–50 GHz
QSO	Quasi-stellar Object
R&D	Research and Development
RET	Research Experiences for Teachers (NSF program)
REU	Research Experiences for Undergraduates (NSF program)
RF	Radio Frequency
RFI	Radio-Frequency Interference
RSS	Really Simple Syndication (web feed format)
S-band	2–4 GHz
SAA	Science and Academic Affairs (NRAO division)
SED	Spectral Energy Distribution
SIA	Simple Image Access
SIAP	Simple Image Access Protocol
SIS	Superconductor–Insulator–Superconductor
SKA	Square Kilometre Array
SMTP	Simple Mail Transfer Protocol
SSA	Simple Spectral Access (NVO term)
submm	submillimeter
TDP	Technology Development Project (SKA)
TRW	TRW Corporation
U-band	12–18 GHz
UDP	User Datagram Protocol
UVa	University of Virginia
UVML	University of Virginia Microfabrication Laboratory

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
VCO	Voltage-Controlled Oscillator
VLA	Very Large Array
VLBA	Very Long Baseline Array
VLBI	Very Long Baseline Interferometry
VO	Virtual Observatory
VSOP	VLBI Space Observatory Program
VSOP-2	VSOP successor
WBS	Work Breakdown Structure
WG	Working Group
WIDAR	Wideband Digital Interferometric Architecture (EVLA correlator)
WWW	World-Wide Web
X-band	8–12 GHz