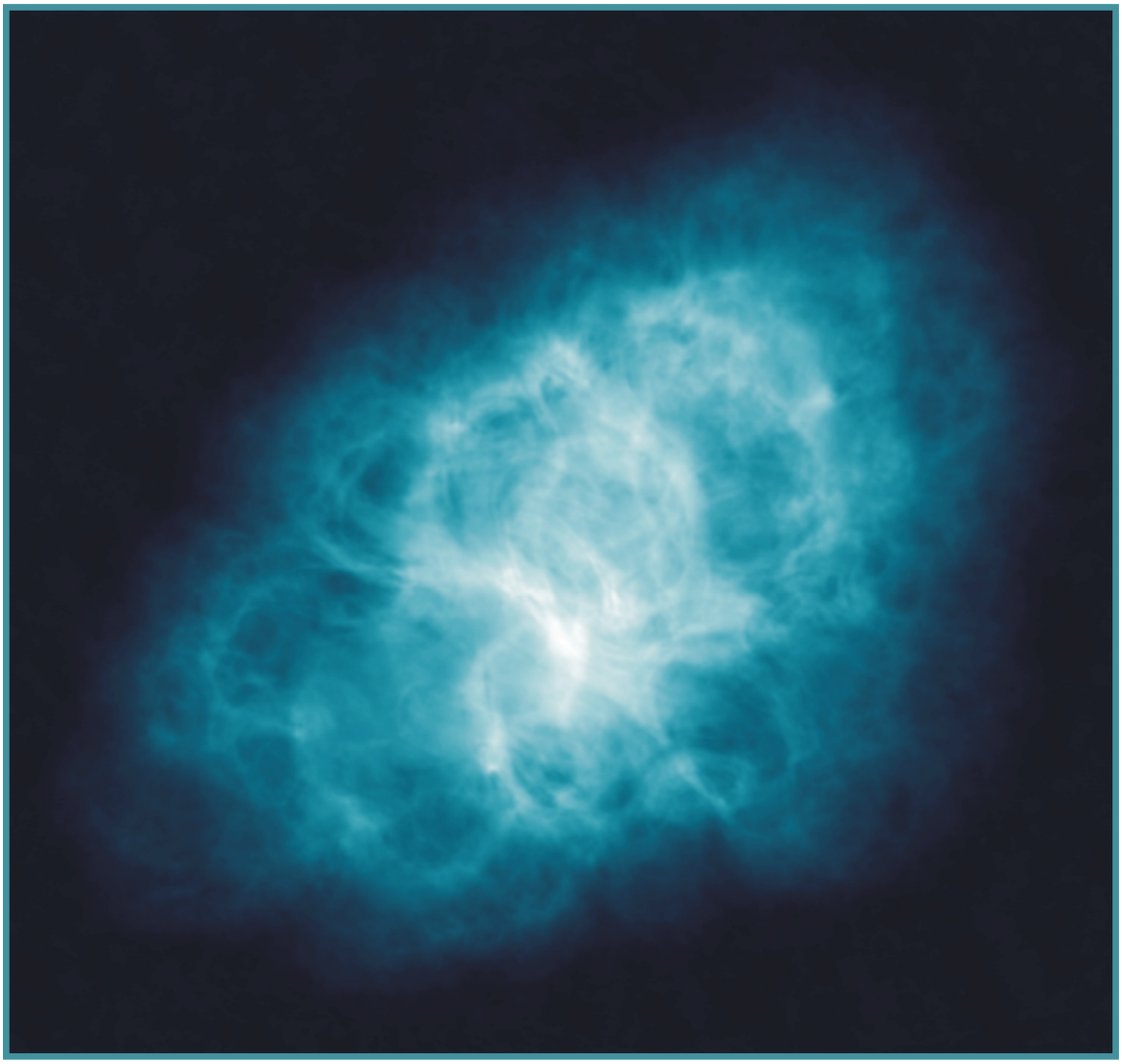
National Radio Astronomy Observatory



Quarterly Report

January – March 2006

NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

JANUARY – MARCH 2006

Cover Image: The Crab Nebula, located in the constellation of Taurus, is the remnant of a supernova in 1054 AD, observed as a "guest star" by ancient Chinese astronomers. Investigator(s): M. Bietenholz

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EXECUTIVE SUMMARY

EVLA

EVLA Antennas 13, 14 and 16 are now functioning with four complete IF's. These antennas are being used by the scientific and technical staff to evaluate the performance of the EVLA hardware and software. The antennas have also been returned to operations, moved out to the array, and are being used in some scientific observations. Antenna 18 is operational with two IF's and is already being used in test observations. The mechanical overhaul of Antenna 24 has just been completed, and it has been moved from the antenna assembly building to the master pad for the installation of new electronics. Antenna 26 has been moved into the antenna assembly building for an azimuth bearing change and its EVLA overhaul. The assembly of the shielded room for the EVLA correlator is complete, and the outfitting of the room with HVAC, electrical, and fire suppression systems is well underway. Encouraging results from tests of the prototype, wideband, orthomode transducer will allow the front end critical design review to proceed in late April 2006. A plan for on-the-sky tests of the prototype WIDAR correlator was developed. Reference pointing is now available on all EVLA antennas.

New Initiatives Office

During the week of March 14, the NRAO hosted meetings of the International SKA Steering Committee, and several of its Working Groups. Following the award of significant DoD funding to UNM, discussions are continuing with NRL and UNM on NRAO's role in supporting the Long Wavelength Array on sites in New Mexico including the VLA site. The NSF did not provide full funding for the FASR Design and Development Proposal this year to the FASR Consortium, but development work will continue at NRAO in FY06. Discussions have begun with Japanese scientists on potential support from NRAO on the VSOP-2 space VLBI project.

Green Bank Telescope

The azimuth track remediation plans were approved by the NSF, and contracts awarded in March. This marks the completion of a significant amount of effort over the last year. The project now moves to the next phase, with initial field measurements scheduled for summer 2006. The actual installation will be performed in summer 2007.

There have been significant staffing and management changes over the last year, since the departure of Phil Jewell to take up the post of the NRAO Deputy Director in Charlottesville. Richard Prestage was appointed Assistant Director for Green Bank Operations, effective February 1, 2006. The Green Bank Deputy Assistant Director position has been replaced by three, more focussed positions: Head of Science Operations (Ron Maddalena), Head of Program Development (Karen O'Neil) and GBT Principal Scientist (Jay Lockman). In addition, Roger Norrod has replaced John Ford as Head of Electronics Division, so that John may take the role of PTCS Project Engineer and devote more time to technical activities. Nicole Radziwill has been promoted to Assistant Director for e2e Operations, and replaced as Head of GB Software Development Division by Amy Shelton (on an interim basis). We look forward to a period of stability with this new team in place.

EXECUTIVE SUMMARY

The Penn Array Receiver has been delayed due to problems in manufacturing the actual detector array. Other receiver work, however, including plans to improve the performance of the Ka and Q-Band receiver, and the Zspectrometer wideband spectrometer (a collaboration with Andy Harris at University of Maryland) are proceeding well.

Very Large Array

The new on-line proposal submission tool for the VLA was released in January, and used successfully for about 60 percent of the VLA proposals at the February proposal deadline. After minor upgrades, this tool will be required at the June 2006 and succeeding deadlines. Newly acquired railroad ballast cars for the VLA site were refurbished, relieving the pressure on a fleet of 40-year old dump trucks that have been used for rail track maintenance. Site preparation was completed for the Long Wavelength Development Array, and the team from the University of New Mexico installed their first test dipole receivers.

Very Long Baseline Array

A structural inspection was carried out on the St. Croix VLBA antenna; this antenna was found to be structurally sound after last year's rust repairs, although considerable rust-proofing work remains necessary for long-term health of the antenna. The complement of Mark 5 playback units at the VLBA correlator reached 10, permitting full Mark 5 operations with all 10 VLBA antennas. Work on upgraded focus-rotation systems at the VLBA sites continued, and a new project was initiated to design a permanent replacement for the original systems, for which required replacement parts are no longer available.

NA ALMA Science Center

Work concentrated this quarter on preparing for an internal review of the NAASC Operations Plan scheduled for April, and in developing a bottom-up WBS for 2006-2013, in preparation for a budget presentation to NSF on April 24.

NAASC personnel organized and conducted the ALMA Town Hall at the AAS meeting in Washington D.C on January 9, 2006 with EPO assistance. The first NAASC workshop "From Z-Machines to ALMA: (Sub)millimeter Spectroscopy of Galaxies" on January 13-14 2006, and was judged to be a tremendous success. Other ALMA-related workshops are in the early planning stages.

The ANASAC met once during this period. Five articles were submitted for the April NRAO Newsletter. A meeting was held to evaluate the status of and set priorities for a spectral line and calibrator database, and a recommended plan was written. NAASC staff participated in test of the offline software system, the pipeline system, and a focus group for the offline systems new user interface.

EXECUTIVE SUMMARY

Central Development Laboratory

Optimization of the designs of low-noise amplifiers for the new EVLA receivers is making good progress; the latest version of the 4-8 GHz amplifier has low noise and improved dynamic range. Amplifier production is keeping pace with EVLA needs. Development work on the noise characteristics of HBT transistors may lead to low-noise amplifier chains with much better 1/f gain fluctuations than those currently available, resulting in much improved broadband radiometers. Good progress is being made in a collaborative effort with UVA to develop repeatable NbTiN tunnel junctions for SIS mixers at frequencies above 700 GHz. The first step toward an integrated balanced SIS mixer has been taken with the successful development of a superconducting IF hybrid.

Good progress is being made in developing the complete new set of feeds for the EVLA; the latest work is a prototype feed for 8-18 GHz (Ku-Band). Design of a dual frequency 300/600 MHz feed for the GBT is in progress.

The Green Bank Solar Radio Burst systems continue to observe the Sun; new receivers and back ends are under construction and are useful for FASR development. A FASR Development Workshop was held for the purposes of refining the scientific objectives for the instrument, translating these objectives into engineering requirements, and exploring various design alternatives. Work on the Portable Array to Probe the Epoch of Reionization (PAPER) to measure the predicted step in the cosmic background amplitude due to neutral hydrogen at the Epoch of Reionization continued; a 32-element prototype array operating at 100-200 MHz is being developed for test deployment at Green Bank.

Chile

An important highlight of this period was the decision that AUI/NRAO will act as the sole employer of Chile local staff for ALMA on behalf of the international collaboration. As a result AUI/NRAO in Chile together with Human Resources in Charlottesville developed the initial version of the required set of basic labor guidelines specific for Chile. These include: (a) Internal Rules and Regulations, (b) a Compensation and Benefits Package, (c) a set of sample work contracts. A job vacancy for the local ALMA Head of HR was issued and a short list has been generated from the 126 applications.

Business support for ALMA construction in Chile continues, with progress in the preparation of infrastructure for antenna I&V, as well as with general services for the Operations Supoort Facility (OSF).

Computer and Information Services

An upgraded email spam mitigation service with quarantining is now available to all employees and to all managed email distribution lists. To improve the accessibility of information on the NRAO's internal web pages, we now have a dedicated Google search engine to provide indexed search capabilities. This is a complementary service to the one already provided to access information available to external users and the general public. We have received the hardware to upgrade the central disk filer in Charlottesville to allow faster access and increased storage (1.4 Terabytes expandable) for general usage. There were no formal security incidents during this quarter.

EXECUTIVE SUMMARY

Education and Public Outreach

EPO crafted and released a RFQ to engage an external consultant who, in collaboration with an internal WWW Tiger Team, will generate and deliver a detailed scope of work, budget, and schedule for the renovation of the Observatory's web site.

Design work for two new Observatory-wide brochures began this quarter. The general public is the target audience for the first of these brochures; the professional astronomical community is the target audience for the second.

The Observatory's three traveling exhibits—NRAO Operations, ALMA, EVLA—were re-designed and debuted at the January American Astronomical Society (AAS) meeting in Washington D.C. New ALMA, EVLA, and GBT brochures were produced and distributed at this AAS meeting. EPO also supported ALMA and EVLA Town Meetings, and organized a press conference and press reception. A full-color 2006 NRAO Calendar was produced using primarily the prize-winning images from the 2005 AUI/NRAO Image Contest. More than 2,500 of these calendars were distributed, and a new poster series was initiated. The 2nd annual NRAO/AUI Image Contest was announced at the January AAS meeting.

EPO personnel collaborated with NRAO and non-NRAO scientists this quarter to produce five press releases (2 VLA, 2 GBT, 1 VLBA). All NRAO press releases with high-quality images or graphics are now also distributed via our *ViewSpace* "Radio Astronomy Update" program to more than 85 science museums and planetariums.

Compared to the same period in 2005, January - March visitation in 2006 increased by 20.6 percent and 18.5 percent, respectively, at the Green Bank Science Center and the VLA Visitor Center. A $7.2M proposal was submitted in January to the New Mexico State Legislature for the design and construction of a new 15,000 square foot Visitor and Education Center at the VLA. The proposal was a NRAO - University of New Mexico collaboration.

Management

Business Services

The available funds for NRAO Operations (without EVLA) total $48,800,359. This amount includes $41,960k in new NSF Funds ($47,400k less $5,440k for EVLA Phase 1 construction), $1,929,616 in prior year commitments, $902,208 in prior year operations carryover and $4,011,535 in Green Bank Track repair carryover. To date, $23,700k in new NSF funds for NRAO Operations has been received.

Environment, Safety, and Security

This quarter, the ALMA Safety Manual was approved and the posted. Efforts are now underway to implement the program. In New Mexico, ES&S led the efforts to recertify the Array Operations Center halon fire protection system. At the VLA, ES&S led the development of a Department of Transportation Drug and Alcohol Testing Program for commercial drivers. At Green Bank, ES&S focused on completion

of the annual hazard communication program. Also, the annual fire alarm and smoke detection inspection was conducted. In Charlottesville, the site life safety program was initiated with the installation of smoke detectors. Future efforts include the schedule for environmental items that were identified in the full site audit.

SCIENCE

1. SCIENCE HIGHLIGHTS

Very Large Array

Counter-rotation in a Protoplanetary Disk **-** High resolution VLA observations of the low-mass star-forming region IRAS 16293-2422 have shown the first evidence for counter-rotation in a protostellar disk. The observations revealed a new protostellar core with a compact inner portion of the disk containing SiO emission counter-rotating with respect to the outer portion of the disk containing ^{13}CO and CS, seen by earlier investigators. This is the first indication of such behavior in a protostellar accretion disk.

Investigators: A. Remijan (NRAO), J. M. Hollis (Goddard).

Very Long Baseline Array

Magnetic Collimation of Jets from an Evolved Star **-** VLBA polarization measurements of the AGB star W43A, which is rapidly undergoing evolution into a planetary nebula, have produced the first direct evidence for magnetic collimation of an astrophysical jet. The VLBA observations measured the polarization of 22 GHz emission from water masers at opposing tips of the jets. The magnetic field direction was shown to be almost perfectly perpendicular to the jet, consistent with a toroidal magnetic field. The magnetic pressure in these regions is seen to dominate the gas pressure by a factor of 2-200. This result supports recent theoretical models that use magnetically collimated jets to explain the shape of asymmetric planetary nebulae.

Investigators: W. Vlemmings and P. Diamond (Jodrell Bank), H. Imai (Kagoshima).

Green Bank

Constraints on Changes in Fundamental Constants from a Cosmologically Distant OH Absorber or Emitter **-** Kanekar et al. have detected the four 18 cm OH lines from the z ~ 0.765 gravitational lens toward PMN J0134 0931. The 1612 and 1720 MHz lines are in conjugate absorption and emission, providing a laboratory to test the evolution of fundamental constants over a large lookback time. They compare the HI and OH main line absorption redshifts of the different components in the z ~ 0.765 absorber and the z ~ 0.685 lens toward B0218+357 to place stringent constraints on changes in $F \equiv g_P[\alpha^2/\mu]^{1.57}$. They obtain $[\Delta F/F] = (0.44\pm0.36^{stat}\pm1.0^{syst}) \times 10^{-5}$, consistent with no evolution over the redshift range $0 < z \lesssim 0.7$. The measurements have a 2σ sensitivity of $[\Delta\alpha/\alpha]<6.7\times10^{-6}$ or $[\Delta\mu/\mu]<1.4\times10^{-5}$ to fractional changes in α and μ over a period of ~ 6.5 G yr, half the age of the Universe. These are among the most sensitive constraints on changes in μ.

Investigators: N. Kanekar, C. L. Carilli, and G. I. Langston (NRAO), G. Rocha (Cavendish Laboratory), F. Combes (Observatoire de Paris), R. Subrahmanyan (Australia Telescope National Facility), J. T. Stocke (University of Colorado), K. M. Menten (Max-Planck-Institut für Radioastronomie), F. H. Briggs (Australia Telescope National Facility and Australian National University), and T. Wiklind (Space Telescope Science Institute).

SCIENCE

1. SCIENCE HIGHLIGHTS

A Gigantic Eruption from the Inner Disk of the Milky Way - Pidopryhora, Lockman and Shields have discovered a coherent structure, which seems to be a huge superbubble reaching higher than 3 kpc from the Galactic plane. It has been detected in both Hα and HI and a detailed HI map of it has been produced with the Green Bank Telescope. The total hydrogen mass within the outflow is ≈ 10^6 solar masses and its energy content is of order 10^{53} ergs. At the top of the structure there is a peculiar "plume" consisting of more than 10^4 solar masses of hydrogen.

Investigators: Y Pidopryhora and F. J. Lockman (NRAO), J. C. Shields (Ohio University).

2. TELESCOPE USAGE

The NRAO telescopes were scheduled for research and maintenance during the first quarter of 2006 as described in the table below. Note that time lost and actual observing for the arrays are computed as fractions of the total antenna arrays. For example, losing 27 VLA antennas for one hour counts as 1.0 hour of time lost, while losing one out of ten VLBA antennas for one hour counts as 0.1 hours of time lost. Also note that in the case of the GBT, Test and Calibrations occasionally require less time than is scheduled for them, and the excess time is then allocated to refereed backup science programs.

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

Telescope Usage			
Activity	**VLA** (hrs)	**VLBA** (hrs)	**GBT** (hrs)
Scheduled Observing	1376.00	1019.00	1714.00
Scheduled Maintenance and Equipment Changes	239.00	242.80	178.00
Scheduled Tests and Calibration	475.00	230.50	268.00
Time Lost	255.85	42.50	151.00
Actual Observing	1120.15	976.50	1563.00

SCIENCE

3. GBT OBSERVING PROGRAMS

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

No.	Observer(s)	Programs
BB184	Braatz, J. (NRAO) Greenhill, L. (CfA) Henkel, C. (MPIfR) Moran, J. (CfA) Wilson, A. (Maryland)	Imaging accretion disks and measuring distances to galaxies. 1.3 cm
BB191	Barvainis, R. (NSF) Ulvestad, J. (NRAO) Birkinshaw, M. (Bristol) Lehar, J. (CombinatoRx)	Are radio-quiet quasars superluminal? 6 cm
BB217	Boyce, E. (MIT) Winn, J. (CfA) Myers, S. (NRAO) Rusin, D. (Pennsylvania) Hewitt, J. (MIT) Keeton, C. (Rutgers)	Observations of gravitational lens central images. 6 cm
BB218	Bietenholz, M. (York) Bartel, N. (York) Rupen, M. (NRAO)	Does the ursa minor dwarf spheroidal host an intermediate mass BH? 21 cm
BH139	Hough, D. (Trinity) Aars, C. (Angelo)	HSA imaging of the faint nucleus in the FR-II radio galaxy 3C441. 3.5 cm
BK127	Knudsen, K. (MPIfA) Walter, F. (MPIfA) Momjian, E. (Arecibo) Carilli, C. (NRAO) Yun, M. (Massachusetts)	Resolving the AGN and the starburst in an intensely starforming quasar. 21 cm
BM238	Momjian, E. (Arecibo) Carilli, C. (NRAO) Walter, F. (MPIfA) Riechers, D. (MPIfA)	Testing the AGN vs. AGN+starburst hypotheses in the z = 4:4 QSO BRI 1335-0417. 21 cm
GBT01A-005	Turner, B. (NRAO) Langston, G. (NRAO)	A high-resolution spectral survey of TMC-1 at Q-Band. 7 mm
GBT04A-006	Bregman, J. (Michigan) Irwin, M. (Michigan)	X-ray astronomy at radio wavelengths (measuring 106 K gas with the NVII radio line). 7 mm

3. GBT OBSERVING PROGRAMS

No.	Observer(s)	Programs
GBT04A-027	Mason, B. (NRAO) Bustos, R. (UdeC) Myers, S. (NRAO) Pearson, T. (Caltech) Readhead, A. (Caltech) Martin, S. (Caltech) Reeves Diaz, R. (UdeC)	Determining the high frequency properties of mJy radio sources. 9 mm
GBT04A-038	Mason, B. (NRAO) Readhead, A. (Caltech) Reeves Diaz, R. (UdeC) Bustos, R. (UdeC) Pearson, T. (Caltech) Myers, S. (NRAO) Shepherd, M. (Caltech)	GBT observations of radio sources in CBI intrinsic anisotropy fields. 9 mm
GBT04B-014	Kondratko, P. (CfA) Greenhill, L. (CfA) Moran, J. (CfA) Braatz, J. (NRAO)	Anchoring the extragalactic distance scale. 1.3 cm, 2 cm
GBT04C-031	Kondratko, P. (CfA) Greenhill, L. (CfA) Moran, J. (CfA) Lovell, J. (ATNF) Kuiper, T. (JPL) Jauncey, D. (ATNF)	Monitoring of five NGC 4258-like water megamasers discovered with the GBT and the DSN. 1.3 cm
GBT04C-043	Ransom, S. (NRAO) Freire, P. (Arecibo) Gupta, Y. (NCRA)	Timing the eccentric millisecond pulsar binary in globular cluster NGC 1851. 70 cm
GBT04C-050	Lane, W. (NRL) Fisher, R. (NRAO) Kanekar, N. (NRAO) Darling, J. (Colorado, Boulder)	Measurement of variable redshifted absorption. 21cm
GBT05A-011	Ransom, S. (NRAO) Camilo, F. (Columbia) Stairs, I. (British Columbia) Kaspi, V. (McGill) Hessels, J. (McGill) Freire, P. (Arecibo)	Timing of the binary and millisecond pulsars in Terzan5. 11 cm
GBT05A-020	Shirley, Y. (Arizona) Li, Z. (Virginia)	The chemical and dynamical state of purportedly nascent pre-protostellar cores in Lynds 1521. 1.3 cm

3. GBT OBSERVING PROGRAMS

No.	Observer(s)	Programs
GBT05A-033	Stairs, I. (British Columbia) Camilo, F. (Columbia) Kramer, M. (Jodrell Bank) Faulkner, A. (Jodrell Bank) McLaughlin, M. (Jodrell Bank) Lorimer, D. (Jodrell Bank) Lyne, A. (Jodrell Bank) Hobbs, G. (ATNF) Manchester, D. (ATNF) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (INAF) Ferdman, R. (British Columbia) Ramachandran, R. (UC, Berkeley) Backer, D. (UC, Berkeley) Demorest, P. (UC, Berkeley) Nice, D. (Princeton)	Shapiro delay in the PSR J1802-2124 system. 21 cm
GBT05A-041	Demorest, P. (UC, Berkeley) Backer, D. (UC, Berkeley) Ferdman, R. (British Columbia) Stairs, I. (British Columbia) Nice, D. (Princeton) Ramachandran, R. (UC, Berkeley)	Precision timing of binary and millisecond pulsars. 21 cm, 38 cm
GBT05B-019	Roberts, M. (Eureka Scientific) Hessels, J. (McGill) Breton, R. (McGill) Ransom, S. (NRAO) Kaspi, V. (McGill)	Examining the intermittent emission of PSR J1744-3922. 11 cm
GBT05B-023	Juett, A. (Virginia) Ransom, S. (NRAO) Chakrabarty, D. (MIT)	A search for radio pulsations from the accreting millisecond X-ray pulsar SAX J1808.4-3658. 6 cm, 11 cm
GBT05B-032	Thorsett, S. (UC, Santa Cruz) Stairs, I. (British Columbia) Arzoumanian, Z. (GSFC)	Timing the millisecond pulsar B1620-26 with the GBT. 21 cm

3. GBT OBSERVING PROGRAMS

No.	Observer(s)	Programs
GBT05B-034	Stairs, I. (British Columbia) Camilo, F. (Columbia) Kramer, M. (Jodrell Bank) Faulkner, A. (Jodrell Bank) McLaughlin, M. (Jodrell Bank) Lyne, A. (Jodrell Bank) Hobbs, G. (ATNF) Manchester, D. (ATNF) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (INAF) Ferdman, R. (British Columbia) Ramachandran, R. (UC, Berkeley) Backer, D. (UC, Berkeley) Demorest, P. (UC, Berkeley) Nice, D. (Princeton)	Timing binary and millisecond pulsars from the Parkes Multibeam Survey. 21 cm
GBT05B-042	Kramer, M. (Jodrell Bank) Stairs, I. (British Columbia) Camilo, F. (Columbia) McLaughlin, M. (Jodrell Bank) Lyne, A. (Jodrell Bank) Manchester, D. (ATNF) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (INAF) Freire, P. (Arecibo) Joshi, B. (TIFR) Ferdman, R. (British Columbia)	Timing and general relativity in the double pulsar system. 21 cm
GBT05B-044	McLaughlin, M. (Jodrell Bank) Possenti, A. (OAC) Stairs, I. (British Columbia) Kramer, M. (Jodrell Bank) Lyne, A. (Jodrell Bank) Lyutikov, M. (McGill) Burgay, M. (INAF) Manchester, D. (ATNF) Freire, P. (Arecibo) Camilo, F. (Columbia)	Studying the interactions in the J0737-3039 system. 90 cm

3. GBT OBSERVING PROGRAMS

No.	Observer(s)	Programs
GBT05C-004	O'Dea, C. (RIT) Gallimore, J. (Bucknell) Baum, S. (RIT) Verdoes Kleijn, G. (KAI) Owen, F. (NRAO) Keel, B. (Alabama) Ledlow, M. (Gemini)	Does radio power depend on black hole mass ? 1.3 cm
GBT05C-009	Joncas, G. (Laval) Bariault, L. (Laval) Boothroyd, A. (Toronto) Landecker, T. (DRAO) Lockman, F. J. (NRAO) Martin, P. (Toronto) Miville-Deschenes, M. (IAS) Taylor, A. (Calgary)	GBT HI observations of the DRAO deep field: determining foregrounds for planck. 21 cm
GBT05C-010	Chin, Y. (Tamkang) Lemme, C. (Tamkang) Kaiser, R. (Hawaii, Manoa)	A search for interstellar benzonitrile (C_6H_5CN) - A key tracer of benzene. 2 cm
GBT05C-014	Devine, K. (Wisconsin, Madison) Chandler, C. (NRAO) Brogan, C. (Hawaii, Manoa) Shirley, Y. (Arizona) Indebetouw, R. (Virginia) Churchwell, E. (Wisconsin, Madison)	Ammonia and CCS observations of GLIMPSE infrared dark clouds. 1.3 cm
GBT05C-015	Henkel, C. (MPIfR) Braatz, J. (NRAO) Ott, J. (ATNF) Menten, K. (MPIfR)	Ammonia in ultraluminous infrared galaxies. 1.3 cm
GBT05C-016	Bolatto, A. (UC, Berkeley) Darling, J. (Colorado, Boulder) Willott, C. (Herzberg Institute)	A search for HI and molecular absorption in an extremely reddened QSO. 70 cm
GBT05C-018	Robishaw, T. (UC, Berkeley) Heiles, C. (UC, Berkeley) Quataert, E. (UC, Berkeley)	OH megamasers in ULIRGs: the mega-obvious place to look for Zeeman splitting! 21 cm
GBT05C-019	Robishaw, T. (UC, Berkeley) Heiles, C. (UC, Berkeley)	The galactic arachnid in the Ursa Major loop. 21 cm

3. GBT OBSERVING PROGRAMS

No.	Observer(s)	Programs
GBT05C-020	Remijan, A. (NRAO) Hollis, J. (GSFC) Lovas, F. (NIST) Jewell, P. (NRAO) Snyder, L. (Illinois)	Confirmation of interstellar methyltriacetylene (CH_3C_6H) toward Tmc-1. 1.3 cm
GBT05C-021	Miville-Deschenes, M. (IAS) Boulanger, F. (IAP) Lockman, F. J. (NRAO) Boothroyd, A. (Toronto) Martin, P. (Toronto)	Characterizing dust in high velocity clouds. 21 cm
GBT05C-022	Braatz, J. (NRAO) Henkel, C. (MPIfR)	The accretion disks and supermassive black holes in NGC 2273 and NGC 4051. 1.3 cm
GBT05C-023	Camilo, F. (Columbia) Ransom, S. (NRAO) Gaensler, B. (CfA) Slane, P. (CfA) Lorimer, D. (Jodrell Bank) Manchester, D. (ATNF)	PSR J1833-1034, the very young pulsar in the SNR G21.5-0.9. 38 cm
GBT05C-026	Devlin, T. (Rutgers) Devlin, M. (Pennsylvania) Mason, B. (NRAO)	Polarization of 30 GHz emission from extra-galactic sources. 3.5 cm, 7 mm
GBT05C-029	Thuan, T. (Virginia) Izotov, Y. (Kiev) Hibbard, J. (NRAO) Hunt, L. (INAF)	The HI content of extremely metal-deficient blue compact dwarf galaxies. 21 cm
GBT05C-031	Kepley, A. (Wisconsin, Madison) Wilcots, E. (Wisconsin, Madison) Robishaw, T. (UC, Berkeley) Heiles, C. (UC, Berkeley) Zweibel, E. (Wisconsin, Madison)	Magnetic fields in dwarf irregular galaxies: NGC 4214. 3.5 cm
GBT05C-032	Shirley, Y. (Arizona) Mangum, J. (NRAO)	Tracing protostellar mass during star formation with 7 mm and 9 mm continuum. 9 mm, 7 mm
GBT05C-033	Krco, M. (Cornell) Goldsmith, P. (JPL)	Structure and formation of the filamentary cloud L204. 21 cm

3. GBT OBSERVING PROGRAMS

No.	Observer(s)	Programs
GBT05C-034	Kameno, S. (NAOJ) Nakai, N. (Tsukuba) Sawada-Satoh, S. (ASIAA, Sinica) Sato, N. (NRO) Yoshikawa, R. (Tokyo)	Water maser tomography through molecular torus of NGC 1052. 1.3 cm
GBT05C-037	Kanekar, N. (NRAO) Carilli, C. (NRAO) Langston, G. (NRAO) Stocke, J. (Colorado, Boulder) Menten, K. (MPIfR) Rocha, G. (Cambridge)	Measuring changes in fundamental constants with redshifted OH lines.
GBT05C-041	Agueros, M. (Washington) Camilo, F. (Columbia) Anderson, S. (Washington)	Detecting pulsar companions to two very low-mass white dwarfs. 38 cm
GBT05C-042	Ransom, S. (NRAO) Freire, P. (Arecibo) Hessels, J. (McGill) Begin, S. (British Columbia) Stairs, I. (British Columbia) Camilo, F. (Columbia) Kaspi, V. (McGill)	Timing the binary and millisecond pulsars in NGC 6440 and NGC 6441. 11 cm
GBT05C-045	Ransom, S. (NRAO) Hessels, J. (McGill) Roberts, M. (Eureka Scientific) Kaspi, V. (McGill)	A 350-MHz survery of the northern galactic plane for pulsars (continued). 90 cm
GBT05C-046	Stairs, I. (British Columbia) Lorimer, D. (Jodrell Bank)	Timing of a relativistic binary and other pulsars from the Arecibo PALFA survey. 21 cm
GBT05C-051	Braatz, J. (NRAO) Gugliucci, N. (Virginia)	A snapshot survey for H_2O megamasers in nearby, luminous galaxies. 1.3 cm
GBT05C-056	Freire, P. (Arecibo) Ransom, S. (NRAO) Stairs, I. (British Columbia) Hessels, J. (McGill) Kaspi, V. (McGill) Camilo, F. (Columbia) Begin, S. (British Columbia)	A GBT S-Band Globular Cluster Survey: Phase B. 11 cm

3. GBT OBSERVING PROGRAMS

No.	Observer(s)	Programs
GBT05C-057	Jorgenson, R. (UC, San Diego) Wolfe, A. (UC, San Diego) Prochaska, J. (UC, Santa Cruz) Darling, J. (Colorado, Boulder)	Search for 21 cm absorption toward radio loud, extremely optically faint sources. 70 cm
GBT05C-063	Robishaw, T. (UC, Berkeley) Heiles, C. (UC, Berkeley)	Sub-zero investigation of spectrometer polarization properties using the NCP. 21 cm
GBT05C-064	Macquart, J. (NRAO) Kanekar, N. (NRAO) Frail, D. (NRAO) Myers, P. (CfA)	A targeted high frequency search for pulsars at the Galactic Center. 2 cm
GBT05C-065	Braatz, J. (NRAO) Gugliucci, N. (Virginia)	Measuring the extragalactic distance scale: A Target of Opportunity. 1.3 cm
GBT06A-001	Fish, V. (NRAO)	SiH: The hiding hydride. 6 cm
GBT06A-003	Clemens, C. (North Carolina) Rosen, R. (North Carolina) Jacoby, B. (NRL)	Observational tests for non-radial oscillations in radio pulsars. 21 cm
GBT06A-008	Minter, A. (NRAO)	A better approach to finding pulsars with OH absorption. 21 cm
GBT06A-009	Condon, J. (NRAO) Braatz, J. (NRAO) Lo, K. Y. (NRAO)	H_0 and Dark Energy. 1.3 cm
GBT06A-011	Blanton, M. (New York) Geha, M. (Carnegie Institute) West, A. (UC, Berkeley)	HI content and dynamics of dwarf disk galaxies. 21 cm
GBT06A-013	Braatz, J. (NRAO) Lo, K. Y. (NRAO)	Finding signatures of a maser disk in a quasar at z=0.66. 2 cm
GBT06A-014	Tarchi, A. (IRAB) Henkel, C. (MPIfR) Brunthaler, A. (MPIfR) Braatz, J. (NRAO)	H_2O vs continuum in the megamaser 3C403: reverberation mapping of the nucleus. 1.3 cm
GBT06A-018	McMullin, J. (NRAO) Balser, D. (NRAO)	Isotopic abundances in planetary nebulae. 7 mm
GBT06A-022	Braatz, J. (NRAO) Gugliucci, N. (Virginia) Frail, D. (NRAO) Markwardt, C. (GSFC) Tueller, J. (GSFC) Gehrels, N. (GSFC)	Water vapor megamasers in an X-ray selected sample of AGNs. 1.3 cm

3. GBT OBSERVING PROGRAMS

No.	Observer(s)	Programs
GBT06A-027	Masters, K. (CfA) Huchra, J. (CfA) Macri, L. (NOAO) Jarrett, T. (IPAC) Crook, A. (MIT)	Mapping matter in the nearby universe with 2MASS. 21 cm
GBT06A-028	Hewitt, J. (Northwestern) Yusef-Zadeh, F. (Northwestern)	Mapping radio recombination line emission toward SNRs W28 and W44. 6 cm
GBT06A-030	Campbell, D. (Cornell) Campbell, B. (Smithsonian Institution) Carter, L. (Smithsonian Institution) Ghent, R. (Smithsonian Institution) Margot, J. (Cornell) Stacy, N. (DSTO)	Lunar surface studies via S-Band radar imagery and interferometry. 11 cm
GBT06A-032	Braatz, J. (NRAO) Lo, K. Y. (NRAO) Jewell, P. (NRAO)	A search for the first SiO megamaser. 7 mm
GBT06A-038	Troland, T. (Kentucky) Lockman, F. J. (NRAO) Robishaw, T. (UC, Berkeley) Benjamin, R. (Wisconsin, Whitewater)	Magnetic fields in the galactic halo via the HI Zeeman effect. 21 cm
GBT06A-039	Camilo, F. (Columbia) Gaensler, B. (CfA) Lorimer, D. (Jodrell Bank) Ransom, S. (NRAO)	Deep searches of three pulsar wind nebulae. 11 cm
GBT06A-042	Sahai, R. (JPL) Claussen, M. (NRAO) Morris, M. (UC, Los Angeles) Sanchez-Contreras, C. (Caltech)	A mysterious outflow source -- protostar, dying star, or something else? 1.3 cm
GBT06A-043	Morgan, L. (NRAO) Urquhart, J. (Leeds) Thompson, M. (Hertfordshire)	OH masers in triggered star forming regions. 21 cm
GBT06A-044	Darling, J. (Colorado, Boulder) Stocke, J. (Colorado, Boulder) Willett, K. (Colorado, Boulder)	Intrinsic HI and OH absorption in compact radio sources at high redshift. 70 cm

3. GBT OBSERVING PROGRAMS

No.	Observer(s)	Programs
GBT06A-046	Langston, G. (NRAO) Turner, B. (NRAO)	A search for the largest interstellar molecule, $HC_{13}N$. 2 cm
GBT06A-049	Readhead, A. (Caltech) Weintraub, L. (Caltech) Mason, B. (NRAO) Pearson, T. (Caltech) Shepherd, M. (Caltech)	Definitive detection of excess arcminute scale CMB anisotropies. 9 mm
GBT06A-050	Begin, S. (British Columbia) Freire, P. (Arecibo) Ransom, S. (NRAO) Stairs, I. (British Columbia) Hessels, J. (McGill) Kaspi, V. (McGill)	Timing of the binary and millisecond pulsars in M28, NGC 6624 and NGC 6522. 11 cm
GBT06A-051	Agueros, M. (Washington) Camilo, F. (Columbia) Silvestri, N. (Washington) Anderson, S. (Washington) Kleinmann, S. (Subaru) Liebert, J. (Arizona)	Detecting pulsar companions to very low-mass white dwarfs. 38 cm
GBT06A-053	Ransom, S. (NRAO) Hessels, J. (McGill) Stairs, I. (British Columbia) Freire, P. (Arecibo) Kaspi, V. (McGill) Camilo, F. (Columbia)	Continued timing of the binary and millisecond pulsars in Terzan 5. 11 cm
GBT06A-054	Demorest, P. (UC, Berkeley) Backer, D. (UC, Berkeley) Ferdman, R. (British Columbia) Stairs, I. (British Columbia) Nice, D. (Princeton) Jacoby, B. (NRL) Bailes, M. (Swiburne) Ord, S. (Sydney)	Long-term precision timing of millisecond pulsars. 38 cm
GBT06A-056	Kondratko, P. (CfA) Greenhill, L. (CfA) Moran, J. (CfA)	Are there unrecognized NGC 4258-like systems among known water masers in AGN? 1.3 cm
GBT06A-060	West, A. (UC, Berkeley) Willman, B. (New York)	A search for HI associated with new Milky Way companions. 21 cm

3. GBT OBSERVING PROGRAMS

No.	Observer(s)	Programs
GBT06A-062	Margot, J. (Cornell) Campbell, D. (Cornell) Jurgens, R. (JPL) Slade, M. (JPL)	Venus spin dynamics. 3.5 cm
GBT06A-066	Nidever, D. (Virginia) Majewski, S. (Virginia) Burton, W. (NRAO)	HI mapping of the extended Magellanic Stream. 21 cm
GBT06A-068	Shirley, Y. (Arizona) Myers, P. (CfA)	The kinematical and chemical structure of pre-protostellar cores. 1.3 cm
GM060	McKean, J. (UC, Davis) Browne, I. (Jodrell Bank) Fassnacht, C. (UC, Davis) Koopmans, L. (Groningen) Porcas, R. (MPIfR)	The dark matter density prole of a moderate redshift group. 6 cm
GM062	Orienti, M. (IRAB) Morganti, R. (NFRA) Dallacasa, D. (IRAB) Oosterloo, T. (NFRA)	What causes the very broad HI absorption in radio galaxies? 21 cm

SCIENCE

4. VLA OBSERVING PROGRAMS

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

No.	Observer(s)	Programs
AA300	Arce, H. (AMNH) Tafalla, M. (OAN) Anglada, G. (IAA, Andalucia)	Imaging ammonia cores in Perseus molecular clouds. 1.3 cm
AA301	Argo, M. (Manchester) Muxlow, T. (Manchester) Beswick, R. (Manchester) Pedlar, A. (Manchester) Wills, K. (Sheffield) Fenech, D. (Manchester)	Monitoring of radio SNe and SNR in nearby starbursts. 2, 3.6, 6, 20 cm
AA302	Argo, M. (Manchester) Muxlow, T. (Manchester) Beswick, R. (Manchester) Pedlar, A. (Manchester) Wills, K. (Sheffield) Aalto, S. (Onsala) Booth, R. (Onsala)	Mainline OH masers in M82 starburst at high velocity resolution. 20 cm
AB1185	Beck, R. (MPIR, Bonn) Berkhuijsen, E. (MPIR, Bonn) Fletcher, A. (Newcastle)	Polarimetry of two regions in M31. 3.6, 6 cm
AB1186	Baker, A. (Paris Obs) Chandler, C. (NRAO) Garcia-Burillo, S. (Obs. National) Lehnert, M. (Leiden)	SiO in the prototypical starburst M82. 0.7 cm
AB1190	Birzan, L. (Ohio State) McNamara, B. (Ohio State) Carilli, C. (NRAO) Rafferty, D. (Ohio State) Nulsen, P. (CfA) Wise, M. (MIT)	Radio sources in clusters and a group with X-Ray cavities. 3.6, 6 cm
AB1193	Barthel, P. (Kapteyn) deZeeuw, P. (Leiden) Peletier, R. (Kapteyn)	Driving nuclear activity in galaxies. 3.5 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AB1194	Bohringer, H. (MPE) Feretti, L. (Bologna) Giovannini, G. (Bologna) Pizzo, R. (Bologna) Sarazin, C. (Virginia) Schuecker, P. (MPIE) Zhang, Y. (MPIE)	Cluster RXCJ1504.1-0248 with aluminous cooling core. 3.6, 20 cm
AB1195	Blomme, R. (Royal Observatory) DeBecker, M. (Liege) Rauw, G. (Liege) Runacres, M. (Brussel) VanLoo, S. (Leeds)	Colliding winds of 0+0 star. 3.6, 6, 20 cm
AB1198	Brunthaler, A. (MPIR, Bonn) deBlock, E. (Mt. Stromlo) Reid, M. (CfA) Henkel, C. (MPIR, Bonn) Falcke, H. (ASTRON)	Water maser survey of NGC 6822. 1.3 cm
AB1199	Berciano-Alba, A. (Groningen) Garrett, M. (JIVE) Koopmans, L. (Groningen) Wucknitz, O. (JIVE)	Deep observations of lensed sub-mm interacting galaxies at z=2.9. 20 cm
AB1201	Bower, G. (UC, Berkeley) Bolatto, A. (UC, Berkeley) Graham, J. (UC, Berkeley) Kalas, P. (UC, Berkeley) Marcy, G. (UC, Berkeley) Matthews, B. (HIA) Wright, J. (UC, Berkeley)	Astrometric detection of planets around nearby stars. 4 cm
AB1204	Bietenholz, M. (York) Bartel, N. (York) Rupen, M. (NRAO)	Spectral evolution of young pulsar nebula/black hole in SN 1986J. 0.7, 1.3, 2, 3.6, 6, cm
AB1205	Bietenholz, M. (York) Bartel, N. (York)	Newly identified plerion G21.5-0.9. 6 cm
AC616	Colina, L. (IFCA) Alberdi, A. (IAA) Torrelles, J. (IEEC-Barcelona) Panagia, N. (STScI) Wilson, A. (Maryland)	Search for new radio supernovae in NGC 7649. 3.6 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AC782	Carilli, C. (NRAO) Walter, F. (MPIA) Knudsen, K. (Leiden) Riechers, D. (MPIA) Bertoldi, F. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Beelen, A. (IAP, Paris) Cox, P. (IAP, Paris) Omont, A. (IAP, Paris)	Search for CO emission from QSO J1048+4637 at z=6.2. 0.7 cm
AC792	Choi, M. (SA/IAA, Taiwan)	SiO study of directional variability of protostellar outflows. 0.7 cm
AC796	Chung, A. (Columbia) van Gorkom, J. (Columbia) Kenney, J. (Yale) Vollmer, B. (MPIR, Bonn) Crowl, H. (Yale) Schiminovich, D. (Caltech)	Imaging HI streamers in the Virgo Cluster. 20 cm
AC803	Carilli, C. (NRAO) Bertoldi, F. (Bonn) Walter, F. (MPIA) Menten, K. (MPIR, Bonn) Fan, X. (Arizona) Strauss, M. (Princeton) Cox, P. (IAP, Paris) Omont, A. (IAP, Paris) Beelen, A. (MPIR, Bonn)	Continuum from z~6 SDSS QSOs. 20 cm
AC804	Claussen, M. (NRAO) Healy, K. (ASU) Bond, H. (STScI) Starrfield, S. (ASU) Woodward, C. (Minnesota) Gehrz, R. (Minnesota) Evans, A. (Keele) Rushton, M. (Keele)	Masers in V838 Mon. 0.7, 1.3 cm
AC805	Croston, J. (Hertfordshire) Hardcastle, M. (Hertfordshire) Kraft, R. (CfA)	Structure and spectrum of radio galaxy NGC 3801. 6, 20 cm
AC807	Capetti, A. (INAF) Axon, D. (RIT) Balmaverde, B. (Torino)	Host galaxy/AGN connection in nearby early-type galaxies. 6 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AC810	Curiel, S. (Mexico/UNAM) Canto, J. (Mexico/UNAM) Ho, P. (CfA) Rodriguez, L. (Mexico/UNAM) Torrelles, J. (IEEC-Barcelona) Patel, N. (CfA)	Monitoring the high mass Cepheus A/HW2 source. 0.7 cm
AC811	Choi, M. (KAO-TRAO)	Water maser at protostellar jet-core impact point. 1.3 cm
AC813	Chatterjee, S. (Cornell) Wasserman, I. (Cornell) Cordes, J. (Cornell) Tye, S.-H. (Cornell)	Continuum search in CLS-1 field. 6 cm
AC814	Chatterjee, S. (Cornell) Lazio, T. (NRL) Vlemmings, W.H.T. (Manchester)	Proper motion for a new relativistic binary pulsar. 20 cm
AC815	Castangia, P. (INAF) Braatz, J. (NRAO) Henkel, C. (MPIR, Bonn) Tarchi, A. (INAF)	H_20 kilomasers in NGC 3556 and NGC 4151. 1.3 cm
AC816	Curiel, S. (Mexico/UNAM)	On the origin of clumpy structure in HL Tau proto planetary disk. 0.7 cm
AC818	Cheung, C. (MIT) Landt, H. (CfA)	Structure of X-shaped FIRST sources. 3.6, 20 cm
AC819	Claussen, M. (NRAO) Healy, K. (ASU) Bond, H. (STScI) Starrfiled, S. (ASU) Woodard, C. (Minnesota) Gehrz, R. (Minnesota) Evans, A. (Keele) Rushton, M. (Keele)	Monitoring the SiO masers in V838 Monocerotis. 0.7, 1.3 cm
AC820	Cameron, P. (Caltech) Frail, D. (NRAO) Kulkarni, S. (Caltech)	Localization and characterization of rotating radio transients. 6, 20 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AD516	Devine, K. (Carleton College) Chandler, C. (NRAO) Brogan, C. (Hawaii) Indebetouw, R. (Virginia) Shirley, Y. (Arizona) Churchwell, E. (Wisconsin)	NH3 and CCS observations of GLIMPSE infrared dark clouds. 1.3 cm
AD519	Dellenbusch, K. (Wisconsin) Gallagher, J. (Wisconsin) Knezek, P. (WIYN Obs.) Wilcots, E. (Wisconsin)	HI in starbursting transition dwarf galaxies. 20 cm
AD520	DeBreuck, C. (ESO) Seymour, N. (Caltech) Klamer, I. (Sydney) Alexander, D. (IoA) Stern, D. (JPL) Vernet, J. (ESO) van Breugel, W. (Lawrence Livermore) Carilli, C. (NRAO)	Polarimetric imaging of radio galaxies observed with Spitzer. 3.6, 6 cm
AD524	DeVine, K. (Wisconsin) Brogan, C. (IfA) Chandler, C. (NRAO) Churchwell, E. (Wisconsin)	Search for massive protostars in GLIMPSE. 3.6 cm
AE156	Eyres, S. (Lancashire) Bode, M. (John Moores) Davis, R. (Manchester) Evans, N. (Keele) O'Brien, T. (Manchester) Porcas, R. (MPIR, Bonn) Uytterhoeven, K. (Lancashire) Worters, H. (Lancashire)	Recurrent nova RS Oph. 1.3, 6, 20 cm
AF400	Fontani, F. (Arcetri) Beltran, M. (Barcelona) Cesaroni, R. (Arcetri) Testi, L. (Arcetri) Walmsley, C. (Arcetri)	Water masers in candidate massive YSOs. 1.3 cm
AF422	Furuya, R. (Caltech) Cesaroni, R. (Arcetri) Shinnaga, H. (Caltech)	Cluster of high-mass protostars in G19.61-0.23. 1.3 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AF427	Finkbeiner, D. (Princeton) Miller, A. (Columbia)	Searching for dark matter with VLA. 20 cm
AF429	Fish, V. (NRAO)	SH radical in Miras. 3.6 cm
AF434	Franco-Hernandez, R. (CfA) Rodriguez, L. (Mexico/UNAM) Moran, J. (CfA)	Time variability in ultra compact HII region NGC 7538 IRS1. 2 cm
AF436	Forbrich, J. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Schreyer, K. (Jena) Henning, T. (Jena)	Water maser and continuum toward candidate massive protostar UYSO1. 1.3, 3.6 cm
AG704	Gaensler, B. (CfA) Kouveliotou, C. (NASA/MSFC) Gelfand, J. (CfA) Taylor, G. (NRAO) Eichler, D. (Ben Gurion) Granot, J. (KIPAC) Wijers, R. (Amsterdam) Ramirez-Ruiz, E. (IAS)	Monitoring the radio afterglow of SGR 1806-20. 3.6, 6 cm
AG710	Giroletti, M. (Bologna) Giovannini, G. (Bologna) Taylor, G. (UNM)	Structure of low-power compact radio galaxies. 1.3, 3.6 cm
AG711	Greaves, J. (St. Andres) Richards, A. (Manchester)	Structure of HL Tau at 5 AU resolution. 1.3 cm
AG715	Gaensler, B. (CfA) Gelfand, J. (CfA) Taylor, G. (UNM) Kouveliotou, C. (NASA) Eichler, D. (Ben Gurion) Lyubarsky, Y. (Ben Gurion) Granot, J. (KIPAC) Ramirez-Ruiz, E. (IAS) Wijers, R. (Amsterdam) Fender, R. (Southampton) Garrett, M. (JIVE)	Imaging and monitoring of afterglow of SGR 1806-20. 3.6 cm
AH877	Helfand, D. (Columbia) Becker, R. (UC, Davis) White, R. (STScI)	Multi-array galactic plane imaging survey. 20 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AH885	Harris, D. (CfA) Junor, W. (LANL) Cheung, C. (MIT)	Monitoring knot HST-1 in M87 jet. 1.3, 2, 3.6 cm
AH892	Hardcastle, M.H. (Hertfordshire) Kraft, R. (CfA) Worrall, D. (Bristol)	Proper motion and variability in jet of Centaurus A. 3.6 cm
AH894	Hyman, S. (Sweet Briar) Lazio, T. (NRL) Ray, P. (NRL) Kassim, N. (NRL) Wijnands, R. (Amsterdam) Muno, M. (UC, Los Angeles)	Monitoring GCRT J1745-3009 and other radio transients in GC. 90 cm
AH899	Helfand, D. (Columbia) Halpern, J. (Columbia) Gotthelf, E. (Columbia) Becker, R. (UC, Davis)	Monitoring anomalous X-ray pulsar XTE J1810-197. 3.6, 20 cm
AH901	Hallinan, G. (NUI, Galway) Golden, A. (NUI, Galway) Doyle, J. (Armagh) Antonova, A. (Armagh) Bourke, S (NUI, Galway)	Multi-frequency obs. of dwarf stars. 3.6, 6, 20 cm
AH904	Humphreys, E. (CfA) Reid, M. (CfA) Menten, K. (MPIR, Bonn)	Search for water masers in Galactic Center. 1.3 cm
AJ324	Johnson, K. (Virginia) Hunt, L. (Arcetri) Hibbard, J. (NRAO) Thuan, T. (Virginia)	Survey for super star clusters in starburst galaxies. 3.6, 6 cm
AJ325	Johnson, K. (Virginia) Hunt, L. (Arcetri) Hibbard, J. (NRAO) Thuan, T. (Virginia)	Survey for super star clusters in low-metallicity galaxies. 1.3, 3.6, 6, 20 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AK583	Kulkarni, S. (Caltech) Soderberg, A. (Caltech) Cenko, S. (Caltech) Frail, D. (NRAO) Harrison, F. (Caltech) Fox, D. (MIT) Gal-Yam, A. (Tel Aviv) Moon, D-S. (Caltech) Cameron, B. (Caltech)	Gamma-ray bursts, x-ray flashes, and core collapse SNe. 0.7, 1.3, 2, 3.6, 6, 20 cm
AK614	Karovska, M. (CfA) Matthews, L. (NRAO)	Monitoring maser line and radio continuum fluxes of Mira. 0.7, 1.3, 3.6, 20 cm
AK620	Kwon, W. (Illinois) Looney, L. (Illinois)	Kinematics of outflows and disks in L1448 IRS3. 0.7, 1.3 cm
AK626	Karovska, M. (CfA) Matthews, L. (CfA)	Multi-frequency continuum monitoring of Mira A & B. 0.7, 1.3, 3.6, 6 cm
AL660	Levy, L. (UNC) Rose, J. (UNC) vanGorkom, J. (Columbia)	Search for HI plumes in galaxies in Pegasus I cluster. 20 cm
AL666	Leipski, C. (Bochum) Bennert, N. (UC, Riverside) Falcke, H. (ASTRON)	Polarimetry of "figure 8" jet of ESO 428-G14. 3.6 cm
AL668	Lovell, J. (ATNF) Jauncey, D. (ATNF) Shabala, S. (Cavendish) Ojha, R. (ATNF) Bignall, H. (JIVE) Kedziora-Chudczer, L. (ATNF) Rickett, B. (UC, San Diego) Macquart, J.-P. (NRAO)	Follow-up of all-sky MASIV IDV survey. 6 cm
AL672	Loinard, L. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Wilner, D. (CfA) Ho, P. (CfA) D'Alessio, P. (Mexico/UNAM)	SED as a function of radius in IRAS 16293-2422B disk. 1.3 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AL673	Lazio, T. (NRL) Brogan, C. (IfA) Gaensler, B. (CfA) Gelfand, J. (CfA) Lazendic, J. (MIT) Kassim, N. (NRL) McClure-Griffiths, N. (ATNF)	Search for PWN and OH masers in TeV SNR G12.8-0.0. 20 cm
AL675	Lee, T.-H. (NOAO) Lim, J. (ASIAA) Kwok, S. (ASIAA)	Structure and spectra of cores of narrow-waist bipolar nebulae. 0.7, 1.3, 2. 3.6 cm
AM821	Marecki, A. (Copernicus/Torun)	Structure of potentially restarted sources. 20 cm
AM831	Monnier, J. (CfA) Greenhill, L. (CfA) Tuthill, P. (Sydney) Danchi, W. (NASA/GSFC)	Monitoring the colliding wind binary WR 112. 3.6 cm
AM842	Morris, M. (UC, Los Angeles) Walter, F. (MPIA)	Imaging the huge HI envelope around IIZw 44. 20 cm
AM843	Macquart, J.-P. (NRAO) deBruyn, A.G. (ASTRON)	Polarimetric monitoring of intra-hour variable quasar J1819+3845. 3.6, 6 cm
AM845	Menten, K. (MPIR) Reid, M. (CfA) Claussen, M. (NRAO) Sahai, R. (JPL)	Imaging carbon star IRC+10216. 0.7, 1.3 cm
AM846	McHardy, I. (Southampton) Moss, D. (Southampton) Seymour, N. (Caltech) Dwelly, T. (MSSL)	Sub-mJy radio sources with X-ray counterparts. 20 cm
AM851	Montenegro-Montes, F. (IRA) Mack, K.-H. (IRA) Vigotti, M. (IRA) Benn, C. (ING) Gonzales-Serrano, J. (Cantabria) Carballo, R. (Cantabria)	SEDS and polarization properties of radio-loud BAL quasars. 0.7, 1.3, 2 cm
AM855	Myers, S. (NRAO) Boyce, E. (MIT) Winn, J. (CfA)	Search for asymmetric gravitational lenses from CLASS. 1.3, 3.6 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AM857	Morrison, G. (IfA) Dickinson, M. (NOAO) Owen, F. (NRAO) Bauer, F. (Columbia) Koekemoer, A. (STScI) Mobasher, B. (STScI) Chary, R-R. (Caltech) Frayer, D. (Caltech) Daddi, E. (NOAO) MacDonald, E. (NOAO) Pope, A. (UBC) Ivison, R. (ROE)	Imaging the GOODS Northern Field at 20 cm
AM858	Miller-Jones, J. (Amsterdam) Fender, R. (Southampton) Rupen, M. (NRAO)	Following transient ejecta of GRS 1915+105 out to arc second scales. 20 cm
AN127	Nakanishi, K. (NAOJ) Okumura, S. (Nobeyama Radio Obs) Kawabe, R. (NAOJ) Kohno, K. (Tokyo) Kuno, N. (NAOJ) Sato, N. (NAOJ)	SED monitoring of luminous infrared galaxy NGC 6240. 1.3, 2, 3.6 cm
AO198	Ofek, E. (Tel Aviv) Frail, D. (NRAO) Gal-Yam, A. (Caltech)	Survey for radio-selected SN. 3.6, 20 cm
AO201	Owen, F. (NRAO) Morrison, G. (IfA) Lonsdale, C. (Caltech) Eilek, J. (NMIMT) Smith, G. (UC, San Diego) Polletta, M. (UC, San Diego)	Imaging the SWIRE deep field. 90 cm
AO202	O'Sullivan, E. (CfA) Harris, D. (CfA) Vrtilek, J. (CfA) Ponman, T. (Birmingham)	Structure of AGN in NGC 3411 galaxy group. 6, 20 cm
AP495	Phan-Bao, N. (IAA) Osten, R. (NRAO) Lim, J. (SA/IAA, Taiwan) Martin, E. (Hawaii)	Emission from brown dwarfs. 3.6 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AP499	Perez-Torres, M. (IAA, Spain) DeBreuck, C. (ESO) Fort, B. (IAP) Gavazzi, R. (Pyrenees, France)	Is the z=3.1 radio galaxy B3 J2330+3927. 1.3 cm
AP500	Pihlstrom, Y. (UNM) Sjouwerman, L. (NRAO)	Monitoring Galactic Center 1720 MHz OH masers. 20 cm
AP501	Perlman, E. (Maryland) Landt, H. (CfA) Padovani, P. (ESO) Giommi, P. (Rome Obs)	Structure of radio quasars with synchrotron peaks in the UV or X-ray. 20 cm
AR570	Rupen, M. (NRAO) Mioduszewski, A. (NRAO) Dhawan, V. (NRAO)	Monitoring of and triggered response to X-ray transients. 0.7, 1.3, 2, 3.6, 6, 20 cm
AR580	Riechers, D. (MPIA) Walter, F. (MPIA) Knudsen, K. (Leiden) Carilli, C. (NRAO) Bertoldi, F. (MPIR, Bonn) Beelen, A. (IAP, Paris) Weiss, A. (Bonn U.) Menten, K. (MPIR, Bonn)	Search for molecules tracing high densities in Cloverleaf QSO. 0.7, 1.3 cm
AR585	Rigby, E. (Edinburgh) Best, P. (Edinburgh) Snellen, I. (Leiden)	Structure of high redshift FR I candidates. 20 cm
AR587	Romani, R. (Stanford) Healey, S. (Stanford) Taylor, G. (UNM) Ulvestad, J. (NRAO) Michelson, P. (Stanford) Sadler, E. (Sydney)	Survey for GLAST blazar candidates. 3.6 cm
AR588	Reid, M. (CfA) Menten, K. (MPIR, Bonn)	Positions and proper motions of SiO maser stars near Sgr A*. 0.7 cm
AS846	Soderberg, A. (Caltech) Kulkarni, S. (Caltech) Frail, D. (NRAO) Chevalier, R. (Virginia)	Type Ibc supernovae. 0.7, 1.3, 2, 3.6, 6, 20 cm
AS858	Sjouwerman, L. (NRAO) Claussen, M. (NRAO)	Circumstellar 1612 MHz OH masers with four spectral peaks. 20 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AS859	Schinnerer, E. (MPIA) Carilli, C. (NRAO) Bertoldi, F. (Bonn) Smolcic, V. (MPIA) Blain, A. (Caltech) Voss, H. (MPIR, Bonn) Scoville, N. (Caltech)	Imaging COSMOS field. 20 cm
AS861	Sahai, R. (JPL) Claussen, M. (NRAO) Morris, M. (UC, Los Angeles) Sanchez-Contreras, C. (Caltech)	Mysterious outflow source – protostar, dying star, or something else? 20 cm
AS863	Suarez, O. (LAEFF) Gomez, J. (LAEFF) Miranda, L. (IAA-CSIC)	H_20 and OH masers in water-fountain source IRAS 16552-3050. 1.3, 20 cm
AS864	Soderberg, A. (Caltech) Frail, D. (NRAO) Kulkarni, S. (Caltech)	Monitoring the bright GRB 030329. 3.6, 6, 20 cm
AS865	Stalder, B. (IfA) Chambers, K. (IfA)	Studies of High-z radio source hosts near bright natural guide stars. 3.6 cm
AS868	Suarez, O. (IAA, Andalucia) Gomez, J. (IAA, Andalucia)	Water masers in PN 18061. 1.3 cm
AS870	Spekkens, K. (Rutgers)	Starless halo or harassment relic? 20 cm
AS875	Soderberg, A. (Caltech)	SN 2006X: young Type Ia SN in Virgo cluster. 3.6, 6 cm
AT313	Tabatabaei, F. (MPIR, Bonn) Krause, M. (CfA) Beck, R. (MPIR, Bonn) Berkhuijsen, E. (MPIR, Bonn)	Correlating MIPS and 20cm images of M33. 20 cm
AT317	Torrelles, J. (IEEC-Barcelona) Dent, W. (UKATC, ROE) Osorio, M. (IAA) Calvet, N. (Michigan) Anglada, G. (IAA)	Circumstellar disc around Herbig AeBe star HD 1691242. 0.7 cm
AT318	Taylor, G. (UNM) Fabian, A. (Cambridge) Allen,S. (Stanford) Gentile, G. (SISSA-Trieste)	Search for emission in high luminosity clusters. 20, 90 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AT319	Tarchi, A. (IRA-Bologna) Brunthaler, A. (MPIR, Bonn) Henkel, C. (MPIR, Bonn) Braatz, J. (NRAO)	Continuum monitoring of megamaser galaxy 3C 403. 1.3 cm
AT320	Tueller, J. (NASA) Markwardt, C. (NASA) Gehrels, N. (NASA) Braatz, J. (NRAO) Frail, D. (NRAO)	Counterparts of unidentified hard X-ray sources. 20 cm
AT321	Taylor, G. (UNM) Fabian, A. (Cambridge) Allen, S. (Stanford) Gentile, G. (SISSA-Trieste) Crawford, C. (Cambridge)	Faraday rotation in Centaurus Cluster. 3.6, 6 cm
AT322	Takano, S. (NAOJ) Nakanishi, K. (NAOJ) Nakai, N. (Tsukuba) Takano, T. (Chiba)	The ammonia absorption of type II SNe. 1.3 cm
AT324	Tsai, C-W. (UC, Los Angeles) Beck, S. (Tel Aviv) Turner, J. (UC, Los Angeles)	Mapping the super star cluster nebula in NGC 7714. 1.3 cm
AT325	Torrelles, J. (IEEC-Barcelona) Rodriguez, L.F. (Mexico/UNAM) Anglada, G. (IAA)	Central region of quadrupolar outflow HH 111. 0.7 cm
AU106	Urrutia, T. (UC, Davis) Becker, R. (UC, Davis) Gregg, M. (UC, Davis)	Observations of dust-obscured quasars. 6 cm
AU108	Umana, G. (INAF) Cerrigone, L. (CfA) Trigilio, C. (INAF)	High resolution obs. of young planetary nebulae. 3.6 cm
AV281	Vollmer, B. (MPIR, Bonn) Beck, R. (MPIR, Bonn) Urbanik, M. (Jagellonian) Otmianowska-Mazur, K. (Krakow) Soida, M. (Jagellonian) Chyzy, K. (Jagellonian) Kenney, J. (Yale) vanGorkom, J. (Columbia)	Polarimetric imaging of Virgo spiral galaxies. 6 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AV285	Verdes-Montenegro, L. (IAA) Yun, M. (Massachusetts) Borthakur, S. (Massachusetts)	HI distribution in Hickson compact groups. 20 cm
AW669	Wyrowski, F. (MPIR, Bonn) Gibb, A. (Maryland) Hatchell, J. (MPIR, Bonn) Pillai, T. (MPIR, Bonn) Thompson, M. (Kent)	Search for ammonia toward cold cores. 1.3 cm
AW672	Williams, P. (Edinburgh) Dougherty, S. (DRAO)	Monitoring the emission from WR 125. 3.6, 6 cm
AW673	Wilner, D. (CfA) Claussen, M. (NRAO) Calvet, N. (Michigan) Hartmann, L. (Michigan)	Imaging the protoplanetary disk inner hole of TW Hya. 0.7 cm
AW675	Weiler, K. (NRL) Stockdale, C. (Marquette) Sramke, R. (NRAO) VanDyk, S. (IPAC) Panagia, N. (STScI) Marcaide, J. (Valencia) Lewin, W. (MIT) Immler, S. (NASA) Pooley, D. (UC, Berkeley) Ryder, S. (AAO)	Triggered observations of type II SNe. 1.3, 2 cm
AW676	Weiler, K. (NRL) Stockdale, C. (Marquette) Sramek, R. (NRAO) VanDyk, S. (IPAC) Panagia, N. (STScI) Marcaide, J. (Valencia) Lewin, W. (MIT) Immler, S. (NASA) Pooley, D. (MIT)	Long term monitoring of radio supernovae. 1.3, 2 cm
AW682	Weiler, K. (NRL) Immler, S. (NASA) Panagia, N. (STScI) Sramek, R. (NRAO) Stockdale, C. (Marquette) VanDyk, S. (Caltech)	Thermo-nuclear SN 2006 X. 1.3 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
AY163	Yi, J. (KASI) Booth, R. (Onsala) Conway, J. (Onsala)	Joint VLA/VLBA observations of SiO masers in two Miras. 0.7 cm
AY165	Yusef-Zadeh,F. (Northwestern) Cotton, W. (NRAO)	Search for extended 7mm emission from Sgr A*. 0.7 cm
AZ168	Zhang, Q. (CfA) Keto, E. (CfA) Ho, P. (CfA)	Molecular kinematics across surface of a hyper compact HII region. 1.3 cm
BB143	Braatz, J. (NRAO) Greenhill, L. (CfA) Henkel, C. (MPIR, Bonn) Moran, J. (CfA) Wilson, A. (UMD)	Imaging nuclear water maser in Mrk 1419. 1.3 cm
BB191	Barvainis, R. (NSF) Ulvestad, J. (NRAO) Birkinshaw, M. (Bristol) Lehar, J. (CombinatoRx)	Radio quiet quasars. 6 cm
BB217	Boyce, E. (NRAO) Winn, J. (CfA) Myers, S. (NRAO) Rusin, D. (Pennsylvania) Hewitt, J. (Massachusetts) Keeton, C. (Rutgers)	Observations of gravitational lens central images. 6 cm
BB220	Boboltz, D. (USNO)	Coordinated VLA/VLTI observations of GX Mon. 0.7 cm
BD109	Dougherty, S. (DRAO) Pittard, J. (Leeds) O'Connor, E. (UPEI) Beasley, A. (NRAO) Claussen, M. (NRAO)	Structural monitoring of colliding wind binary WR140. 1.3, 2, 3.6 cm
BG161	Gabuzda, D. (Cork) Moloney, B. (Cork) deBruyn, A. (ASTRON) Macquart, J.-P. (NRAO) Gurvits, L. (JIVE)	Polarimetric imaging of scintillating quasar J1819+3845. 1.3, 2 cm
BH139	Hough, D. (Trinity) Aars, C. (Angelo State)	Imaging the faint nucleus in FRII radio galaxy 3C 441. 3.6 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
BK127	Knudsen, K. (MPIA) Walter, F. (MPIA) Momjian, E. (Arecibo) Carilli, C. (NRAO) Yun, M. (Massachusetts)	Imaging two submm-bright quasars at redshift 2.8. 20 cm
BM238	Momjian, E. (Arecibo) Carilli, C. (NRAO) Walter, F. (MPIA) Riechers, D. (MPIA)	Imaging the FIR-luminous QSO BRI 1335-0417 at redshift 4.4. 20 cm
S70551	Migliari, S. (Amsterdam) Fender, R. (Southampton) Miller-Jones, J. (Amsterdam) vanderKlis, M. (Amsterdam) Tomsick, J. (UC, San Diego)	Chandra/VLA observations of jets of SS 433. 6 cm
S70998	Miller, J. (CfA) Markoff, S. (MIT) Nowak, M. (MIT) Rupen, M. (NRAO) Steeghs, D. (CfA)	Chandra/VLA observations of LLAGN M81*. 3.6 cm
S71062	Harris, D. (CfA) Birkinshaw, M. (Bristol) Cheung, C. (MIT) Gelbord, J. (MIT) Landt, H. (CfA) Jorstad, S. (Boston) Marshall, H. (MIT) Perlman, E. (Maryland) Schwartz, D. (CfA) Stawarz, L. (CfA) Worrall, D. (Bristol)	Chandra/VLA observations of quasar 4C 19.44. 6, 20 cm

4. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs
S70702	Miller, J. (CfA) Charles, P. (CfA) Fabian, A. (Cambridge) Lewin, W. (MIT) Raymond, J. (CfA) Reynolds, C. (Maryland) Rupen, M. (NRAO) Smith, J. (MIT) Steeghs, D. (CfA) vander Klis, M. (Amsterdam) Wijnands, R. (Amsterdam)	Chandra/VLA observations of black hole transient. 20 cm

SCIENCE

5. VLBA OBSERVING PROGRAMS

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

No.	Observer(s)	Programs
BB184	Braatz, J. (NRAO) Greenhill, L. (CfA) Henkel, C. (MPIR, Bonn) Moran, J. (CfA) Wilson, A. (Maryland)	Imaging nuclear H2O masers in NGC 4388, NGC 5728 and NGC 6323. 1.3 cm
BB191	Barvainis, R. (NSF) Ulvestad, J. (NRAO) Birkinshaw, M. (Bristol) Lehar, J. (CombinatoRx)	Radio-quiet quasars. 6 cm
BB200	Brunthaler, A. (JIVE) Falcke, H. (ASTRON) Greenhill, L. (CfA) Henkel, C. (MPIR, Bonn) Reid, M. (CfA)	Geometric distance to M33: proper motion of M33/50. 1.3 cm
BB213	Brisken, W. (NRAO) Romani, R. (Stanford)	Pulsar J0538+2817. 21 cm
BB217	Boyce, E. (NMIMT) Winn, J. (CfA) Myers, S. (NRAO) Rusin, D. (CfA) Hewitt, J. (Massachusetts) Keeton, C. (NRAO)	Observations of gravitational lens central images. 6 cm
BB218	Bietenholz, M. (York) Bartel, N. (York) Rupen, M. (NRAO)	Structure of source near center of Ursa Minor dSph galaxy. 20 cm
BB220	Boboltz, D. (USNO) Driebe, T. (MPIR, Bonn) Ohnaka, K. (MPIR, Bonn) Wittkowski, M. (ESO)	Coordinated VLBA/VLTI obs. of GX Mon. 0.7 cm
BB221	Brunthaler, A. (MPIR, Bonn) Castangia, P. (Oss. di Cagliari) Falcke, H. (ASTRON) Henkel, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Reid, M. (CfA) Tarchi, A. (IRA)	Nuclear H_20 maser in NGC 253. 1.3 cm

5. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs
BB222	Bower, G. (UC, Berkeley) Basri, G. (UC, Berkeley) Bolatto, A. (UC, Berkeley) Ford, E. (UC, Berkeley) Goldstone, J. (UC, Berkeley) Graham, J. (UC, Berkeley) Kalas, P. (UC, Berkeley) Marcy, G. (UC, Berkeley) Matthews, B. (HIA) Sandstrom, K. (UC, Berkeley) Wright, J. (UC, Berkeley)	Astrometric detection of planets around nearby stars. 3.6 cm
BC152	Claussen, M. (NRAO) Marvel, K. (AAS) Simpson, C. (Wellesley) Wilking, B. (UMSL) Wootten, H. A. (NRAO)	Parallax and proper motions of water masers. 1 cm
BC156	Claussen, M. (NRAO) Bond, H. (STScI) Gehrz, R. (Minnesota) Healy, K. (ASU) Starrfield, S. (ASU) Woodward, C. (Minnesota)	SiO masers in V838 Monocerotis. 0.7 cm
BC159	Claussen, M. (NRAO) Sjouwerman, L. (NRAO)	Possible bipolar pre-planetary nebula OH19.2-0.1. 20 cm
BC161	Cotton, W. (NRAO) Danchi, W. (NASA) Lacasse, M. (CfA) Ragland, S. (CfA Schloerb, P. (Massachusetts) Townes, C. (UC, Berkeley) Traub, W. (CfA)	Obs. of Miras with photospheric asymmetries II. 0.7 cm
BD105	Dhawan, V. (NRAO) Fomalont, E. (NRAO) Lestrade, J. (Paris) Mioduszewski, A. (NRAO) Rupen, M. (NRAO)	Astrometry of X-ray binaries. 2, 4 cm

5. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs
BD108	Dodson, R. (ISAS) Alcolea, J. (OAN) Bujarrabal, V. (OAN) Colomer, F. (OAN) Rioja, M. (OAN) Soria-Ruiz, R. (OAN)	Frequency phase transfer astrometry to align AGB star maser images. 0.3, 0.7 cm
BD109	Dougherty, S. (DRAO) Pittard, J. (Leeds) O'Connor, E. (UPEI) Beasley, A. (Caltech) Claussen, M. (NRAO)	Structural monitoring of colliding-wind binary WR140. 0.7, 1.3, 2, 3.6, 6, 18 cm
BD112	Doi, A. (Yamaguchi) Asada, K. (NAOJ) Harada, K. (Yamaguchi) Inoue, M. (NAOJ) Kameno, S. (NAOJ) Nagai, H. (NAOJ) Wajima, K. (KAO)	Radio loud narrow-lie Seyfert 1s. 20 cm
BD115	Dodson, R. (ISAS) Alcolea, J. (OAN) Bujarrabal, V. (OAN) Colomer, F. (OAN) Rioja, M.J. (OAN) Soria-Ruiz, R. (JIVE)	Frequency phase transfer astrometry to align AGB star maser images. 0.7 cm
BF075	Filho, M. (Ist. de Radioastronomie) Barthel, P. (Kapteyn) Nagar, N. (Kapteyn)	Jets in composite LINER/HII nuclei. 2, 13, 5, 20 cm
BF088	Fish, V. (NRAO) Harris, D. (CfA) Cheung, C. (Kavli) Junor, W. (LLNL)	Multi-frequency hydroxyl maser obs. of G11.90-0.14. 2 cm
BG161	Gabuzda, D. (Cork) Moloney, B. (Cork) deBruyn, A. (ASTRON) Macquart, J.-P. (NRAO) Gurvits, L. (JIVE)	Polarimetric imaging of scintillating quasar J1819+3845. 0.7, 1.3, 2, 6 cm

5. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs
BG164	Guglicucci, N. (Virginia) Giroletti, M. (INAF) Peck, G. (CfA) Taylor, G. (UNM)	Investigating Faraday screens for two compact symmetric objects. 2 cm
BH135	Harris, D. (SAO) Cheung, C. (Massachusetts) Junor, W. (LANL)	Flare decay of Knot 'HST-1' in the M87 jet. 20 cm
BH136	Hachisuka, K. (MPIR, Bonn) Brunthaler, A. (JIVE) Hagiwara, Y. (NAOJ) Menten, K. (MPIR) Mochizuki, N. (ISAS) Reid, N. (CfA)	Astrometry of H_20 maser sources in outer part of the galaxy. 1.3 cm
BH139	Hough, D. (Trinity) Aars, C. (Angelo State)	Imaging the faint nucleus in FRII radio galaxy 3C 441. 3.6 cm
BK127	Knudsen, K. (Leiden) Walter, F. (MPIA) Momjian, E. (Kentucky) Carilli, C. (NRAO) Yun, M. (Massachusetts)	Imaging two sub mm-bright quasars at redshift. 18 cm
BK129	Kameno, S. (NAOJ) Nakai, N. (Tsukuba) Sato, N. (Nobeyama) Sawada-Satoh, S. (SA/IAA, Taiwan) Yoshikawa, R. (Tokio)	Water maser tomography through molecular Torus of NGC 1052. 0.7, 1, 2, 4 cm
BK130	Fomalont, E. (NRAO) Gordon, D. (Raytheon) Kovalev, Y. (NRAO) Petrov, L. (NASA)	Northern polar cap VLBA survey. 3.6 cm
BL128	Loinard, L. (Mexico/UNAM) Mioduszewski, A. (NRAO) Rodriguez, L. (Mexico/UNAM) Torres, R. (Mexico/UNAM)	Distance to Taurus and Ophiuchus. 2, 4 cm

5. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs
BL137	Lister, M. (Purdue) Aller, H. (Michigan) Aller, M. (Michigan) Arshakian, T. (MPIR, Bonn) Homan, D. (Denison) Kadler, M. (MPIR, Bonn) Kellerman, K. (NRAO) Kovalev, Y. (NRAO) Lobanov, A. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Vermeulen, R. (ASTRON) Zensus, J.A. (MPIR, Bonn)	MOJAVE II Program. 2 cm
BL138	Leurini, S. (MPIR, Bonn) Beuther, H. (CfA) Menten, K. (MPIR, Bonn) Moscadelli, L. (Cagliari)	Complementing thermal with H_20 and CH_3 OH maser obs. in massive YSO IRAS 05358+3543. 1 cm
BL139	Lobanov, A. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Arshakian, T. (MPIR, Bonn) Chavushyan, V. (INAOE) Mercado, A. (INAOE) Shapovalova, A. (SAO)	Parsec-scale radio emission, accretion disk and broad-line region in 3C 390.3. 1.3, 2 cm
BM229	Marscher, A. (Boston) Aller, M. (Michigan) D'Arcangelo, F. (Boston) Jorstad, S. (Boston) McHardy, I. (Southampton)	Probing compact jets through multi-waveband variability. 0.7 cm
BM230	Marscher, A. (Boston) McHardy, I. (Southampton) Aller, M. (Michigan) Jorstad, S. (Boston) McHardy, I. (Southampton) Wannawichian, S. (Boston)	Relation between the X-ray state and energy flow into jets of radio galaxies. 0.7 cm
BM232	Marvel, K. (AAS) Boboltz, D. (USNO)	Measuring proper motions of H_20 masers toward OH12.8-0.9. 1 cm
BM234	Menten, K. (MPIR, Bonn) Reid, M. (CfA)	Parallax and proper motion of Orion X-ray stars. 3.6 cm

5. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs
BM235	Moellenbrock, G. (NRAO) Beasley, A. (NRAO) Claussen, M. (NRAO) Goss, W.M. (NRAO)	Parallax and proper motions of galactic water masers. 1 cm
BM238	Momjian, E. (Kentucky) Carilli, C. (NRAO) Walter, F. (MPIA) Riechers, D. (MPIA)	Imaging the FIR-luminous QSO BRI 1335-0417 at redshift 4.4. 18 cm
BM245	Marscher, A. (Boston)	Blazar monitoring during a ten day submm/ir/optical campaign. 0.7 cm
BM249	Miller-Jones, J. (Amsterdam) Fender, R. (Southampton) Rupen, M. (NRAO)	Following the transient ejecta of GRS 1915+105 out to arc second scales. 3.6 cm
BN035	Nagar, N. (Univ. de Concepcion) Eracleous, M. (Penn State) Storchi-Bergmann, T. (UFRGS, Brazil) Strateva, I. (Penn State)	SDSS galaxies with double peaked broad H lines. 6 cm
BO022	Ohnaka, K. (MPIR, Bonn) Boboltz, D. (USNO) Diebe, T. (MPIR, Bonn) Murakawa, K. (MPIR, Bonn) Wittkowski, M. (ESO)	Solve the silicate carbon star puzzle. 1 cm
BO026	O'Brien, T. (Manchester) Bode, M. (John Moores) Davis, R. (Manchester) Evans, A. (Keele) Eyres, S. (Central Lancashire) Porcas, R. (MPIR, Bonn)	Resolving the radio emission from the 2006 outburst of the recurrent nova RS Ophiuchus. 6 cm
BP119	Pal, S. (Centre for Space Physics) Chakrabarti, S. (SNBNCBS, India)	Multi-wavelength obs. of SS 433 in flare. 6 cm
BP124	Punsly, B. (Boeing) Ulvestad, J. (NRAO) Wrobel, J. (NRAO)	Imaging the inner 1 parsec of Mrk 231. 2 cm
BP126	Papageorgiou, A. (Lancashire) Cawthorne, T. (Lancashire)	Polarimetry of knot K1 in 3C 380. 6 cm

5. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs
BP129	Parra, R. (Onsala) Conway, J. (Onsala) Diamond, P. (Manchester) Thrall, H. (Manchester)	Confirmation and follow up of new bright radio supernova. 3.6, 13 cm
BR099	Ros, E. (MPIR, Bonn) Aller, H. (Michigan) Aller, M. (Michigan) Kadler, M. (MPIR, Bonn) Kerp, J. (Univ. Bonn) Kovalev, Y. (NRAO) Marscher, A (Boston). Weaver, K. (NASA/GSFC) Zensus, J.A. (MPIR, Bonn)	NGC 1052, key to explore the disk-jet connection in AGN. 0.7, 1 cm
BR100	Reid, M. (CfA) Greenhill, L. (CfA) Menten, K. (MPIR, Bonn) Moscadelli, L. (Cagliari) Xu, Y. (Nanjing) Zheng, X. (Nanjing)	Spiral structure and kinematics of the Milky Way. 2 cm
BR119	Ros, E. (MPIR, Bonn) Aller, H. (Michigan) Aller, M. (Michigan) Angelakis, E. (MPIR, Bonn) Irwin, J. (Michigan) Kadler, M. (NASA) Kerp, J. (Argelander Inst.) Kovalev, Y. (NRAO) Marscher, A. (Boston) Weaver, K. (NASA) Zensus, J.A. (MPIR, Bonn)	NGC 1052, key to explore the disk jet connection in AGN continuation of VLBA campaign. 1.3, 0.7 cm
BS150	Savolainen, T. (Tuorla Obs) Rastorgueva, E. (Tuorla Observatory) Takalo, L. (Tuorla Obs) Valtaoja, E. (Tuorla Obs) Valtonen, M. (Tuorla Obs) Wiik, K. (Tuorla Obs)	Multi-frequency polarimetric monitoring of next predicted outburst in OJ287. 0.3, 0.7, 1, 2, 4 cm

5. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs
BS161	Szymczak, M. (Torun) Bartkiewicz, A. (Torun) Diamond, P. (Manchester) Gerard, E. (Obs. de Paris)	Polarized OH outburst in a proto-planetary nebulae. 20 cm
BS167	Sokoloski, J. (CfA) Brocksopp, C. (MSSL) Kaiser, C. (Southampton) Mioduszewski, A. (NRAO) Rupen, M. (NRAO)	Expanding shell and jet of RS Ophiuchus. 3.6, 13 cm
BT085	Taylor, G. (UNM) Blandford, R. (Stanford) Fassnacht, C. (UC, Davis) Gehrels, N. (NASA) Michelson, P. (Stanford) Myers, S. (NRAO) Pearson, T. (Caltech) Readhead, T. (Caltech) Romani, R. (Stanford) Sjouwerman, L. (NRAO) Ulvestad, J. (NRAO) Walker, R. C. (NRAO) Weintraub, L. (Caltech)	VLBA Imaging and polarimetry survey (VIPS). 2, 3.6 cm
BV059	Vlemmings, W. (Manchester) Torrelles, J. (CSIC) vanLangevelde, H. (JIVE)	Co-evolution of methanol and water maser filaments in Cepheus A star forming region. 1.3, 2 cm
BY021	Yi, J. (KASI) Booth, R. (Onsala) Conway, J. (Onsala)	Joint VLA/VLBA observations of SiO masers in two Miras. 0.7 cm
GC025	Charlot, P. (Bordeaux) Pradel, N. (Bordeaux) Lestrade, J.-F. (Meudon)	Phase-reference astrometry of compact symmetric objects. 3.6 cm
GK034	Kharb, P. (Rochester) Shastri, P. (IAA) Gabuzda, D. (Cork) O'Dea, C. (Rochester) Baum, S. (Rochester)	Parsec-scale polarization in FRI and FRII radio galaxies. 3.6 cm

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5. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs
GM060	McKean, J. (UC, Davis) Browne, I. (Manchester) Fassnacht, C. (UC, Davis) Koopmans, L. (Groningen) Porcas, R. (MPIR, Bonn)	Structure in lensed images of CLASS B2108+213. 6 cm
GM062	Orienti, M. (Bologna) Morganti, R. (ASTRON) Dallacasa, D. (Bologna) Oosterloo, T. (ASTRON)	Imaging the very broad HI absorption in radio galaxies. 20 cm
RDV055	Gipson, J. (NASA) Johnston, K. (USNO) Fey, A. (USNO) Ma, C. (NASA) Gordon, D. (Raytheon) Boboltz, D. (USNO) Kingham, K. (USNO) Behrend, D. (NVI-GSFC) Gipson, J. (NVI-GSFC) MacMillan, D. (NVI-GSFC) Petrov, L. (NASA) Fomalont, E. (NRAO) Walker, R.C. (NRAO)	Geodesy/astrometry observations for 2006. 3.6 cm

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PROJECTS

1. EVLA

Expanded Very Large Array Milestones

Milestones	Original Date	Revised Date	Date Completed
1. First fringes at X-Band on Antenna 13	01-10-06		01-06-06
2. New release proposal submission tool	01-10-06		01-10-06
3. M302 design complete w- test fixture	11-07-05	01-13-06	01-13-06
4. 4 IF's on Antenna 13 working	11-10-05	01-25-06	01-25-06
5. L-Band wideband receiver assembled	09-23-05	01-20-06	01-27-06
6. Antenna 16 turnover to Operations	07-28-05	01-10-06	01-30-06
7. Fiber path length tests	02-01-06		02-01-06
8. Telcal component fundamentally finished	11-30-05	01-16-06	02-13-06
9. L353 Module MIB ICD ready for software development	01-31-06		02-14-06
10. Develop feed moisture monitoring plan	02-22-06		02-22-06
11. Verify single scan fringe loss	02-27-06		02-27-06
12. Test use of B1950 coordinates	02-27-06		02-27-06
13. Final version of antenna VOIP phone	10-31-05	02-28-06	02-28-06
14. Central LO-rack (21-28) ready for use	02-15-06		03-01-06
15. Deformatter boards for Antenna 24 ready for use	03-03-06		03-03-06
16. Reference pointing observing with EVLA antennas	01-31-06		03-06-06
17. Eliminate phase jump with frequency change	03-07-06		03-07-06
18. Preliminary on-the-sky test plan completed	11-30-05	03-15-06	03-10-06
19. Telcal component functional	03-13-06		03-13-06
20. Decision made on 3-bit sampler design	02-15-06		03-13-06
21. Antenna 18 operating with 2 IF-bands	03-15-06		03-15-06
22. Implement utility module (M302-3) software functionality, GUI	03-17-06		03-17-06
23. 4-P-Band capability on Antenna 14	03-21-06		03-21-06
24. Two F317 modules w- MIB tested and ready for software	09-08-04	01-27-06	03-27-06
25. Hardware acceptance tests on Antenna 13 complete	09-28-05	01-27-06	03-28-06
26. Feed moisture filtration prototype installed	01-25-06		03-29-06
27. Antenna 13 turnover to Operation	03-29-06		03-29-06
28. Project book updated	02-28-06	03-31-06	
29. Test focus change with elevation	04-03-06		
30. Correlator face-to-face meeting	04-05-06		

PROJECTS

1. EVLA

Milestones	Original Date	Revised Date	Date Completed
31. Complete M302-3 functionality tests - hardware	04-10-06		
32. Requirements for final version of Observation Executor complete	07-14-05	04-10-06	
33. Determine polarization properties of L-Band feed	04-10-06		
34. Document Doppler tracking workaround	04-10-06		
35 Implement F317 software functionality	04-11-06		
36. Evaluate round-trip monitor data, L352-353	04-12-06		
37. Begin feed moisture monitoring	04-13-06		
38. L302 module firmware updated and tested	02-28-06	04-14-06	
39. 1.5 GHz wideband receiver lab test complete	02-03-06	04-15-06	
40. M301 module ready to install on antenna	06-08-05	04-15-06	
41. Total power detector added to baseband converter	02-15-06	04-20-06	
42. Project data model meeting with ALMA	04-20-06		
43. Utility module (M302) prototype installed	03-01-06	04-21-06	
44. L-Band wideband receiver installed	04-21-06		
45. Complete Part 2 hardware bench integration	03-03-03	04-21-06	
46. Front Ends CDR	03-05-05	04-24-06	
47. 4-P converter w-M301 ready for use	10-14-05	04-25-06	
48. Receiver stability tests: 8, 22 and 45 GHz	12-19-03	04-28-06	
49. Check for interference and bandpass shapes: 8, 22 & 45 GHz – written report	03-15-04	04-28-06	
50. Report on Receiver stability, bandpass shapes, linearity of RF design	08-12-05	04-28-06	
51. Improve TP detectors for auto level setting (software)	04-28-06		
52. Specify extensions to EVLA script and obs2script	10-17-05	05-01-06	
53. Initial EVLA antenna OPS checkout procedure available	05-01-06		
54. Updated HLA	05-01-06		
55. Antenna 18 with 4 IF-bands working	05-03-06		
56. Hardware acceptance tests complete on Antenna 18	05-05-06		
57. 4 IF's on Antenna 18 working	12-13-05	05-05-06	
58. Implement automatic level setting	05-08-06		
59. EVLA Advisory Committee Meeting	05-08-06		
60. VLBA data in ALMA science data model	05-08-06		

PROJECTS

1. EVLA

Milestones	Original Date	Revised Date	Date Completed
61. New release proposal submission tool	05-10-06		
62. NSF EVLA Review Meeting	05-11-06		
63. Correlator shielded chamber flooring installed	05-12-06		
64. New release proposal handling tool	05-14-06		
65. First correlator chip prototype delivered	11-28-05	05-15-06	
66. RTP data multicast from L352, w- listener thread in interim Observation Executor	07-29-05	05-22-06	
67. Hardware acceptance tests complete on Antenna 24	05-23-06		
68. VLA antenna setup w- Observation Executor	10-14-05	05-31-06	
69. GUI's available for initial EVLA antenna OPS checkout	06-01-06		
70. New release observation preparation tool	06-01-06		
71. Investigate probable error in Tsys measurement	06-05-06		
72. Implement antenna auto phasing	06-05-06		
73. Start transition mode observing	03-15-05	06-05-06	
74. Access to archive tool via portal	06-14-06		
75. Agreement on common project software model	09-01-05	06-15-06	
76. New VLA correlator controller operational, controlled from Modcomps	08-30-05	06-30-06	
77. Include current weather data for pointing	06-19-06		
78. New VLA correlator controller controlled from EVLA M&C system	11-30-05	09-29-06	
79. Archive records written using Modcomp independent format	03-13-06	12-29-06	

Notes:
46. FE CDR slightly delayed to allow the evaluation of the L-Band receiver and wideband OMT.
47. Board layout errors on the 4-P converter have been corrected.
48, 49, 50. Documenting receiver stability has been delayed due to the pressing need to troubleshoot antenna and electronics performance issues.

Project Management

The activities completed by the EVLA project office over the last quarter include the preparation of the NSF semiannual report, the setup of project data for the implementation of electronic time keeping, and the update of WBS cost data and schedule.

PROJECTS

1. EVLA

Peter Napier stepped down as EVLA Project Manager in January 2006 to take on a new role as an ALMA Systems Integration Engineer. He was replaced by Mark McKinnon.

Systems Integration

EVLA Antennas 13, 14, and 16 are now functioning with four complete IF's. These antennas are being used by the scientific and technical staff to evaluate the performance of the EVLA hardware and software. They have also been returned to operations, moved out to the array, and are being used in some scientific observations. Antenna 18 is operational with two IF's and needs only a few modules for full, 4-IF functionality. Antenna 18 is already being used in test observations. When first powered up, Antennas 13 and 18 came to life virtually immediately, and the astronomers checking them out were able to obtain fringes on the first attempt. The mechanical overhaul of Antenna 24 has just been completed, and it has been moved from the antenna assembly building to the master pad for the installation of new electronics. Antenna 26 has been moved into the antenna assembly building for an azimuth bearing change and its EVLA overhaul.

Civil Construction

Work continues on the outfitting of the shielded room for the new correlator. The computer flooring contract was issued in December 2005, and the installation of the main correlator floor will start in April 2006. The under floor liner was installed in December 2005. Contract work for the FM200 fire suppression system in the shielded room was started in November 2005 and is approximately 50 percent complete. This work should be complete in the second quarter 2006. The water sprinkler system and pre-action cabinet are installed, but still have to be electrically wired. When complete, the FM200 and water sprinkler system with pre-action cabinet will be interlocked. The sprinkler system will act as a redundant fire protection system in the event the FM200 fails to extinguish any fire. Power distribution equipment and cabling to the correlator room will be complete by the middle of April 2006. Room lighting will be installed in late April. HVAC equipment for the correlator room was received in March and will be installed in late April or early May. An RFQ for the HVAC equipment plumbing will be issued in April. An insulation contract was also issued for the HVAC equipment plumbing in March. The installation of power and plumbing to the HVAC equipment will begin in April.

Antennas

The mechanical outfitting of Antenna 24 was completed. Antenna 24 received the first EVLA X-Band feed horn. Previous EVLA antennas have the original, JPL X-Band horns. The fabrication of mechanical components for the next EVLA antenna (26) has begun.

The fiberglass lamination of L-Band feed horns 1 through 10 is complete. The lamination of horn 11 is in progress. Feed moisture detectors were designed and installed on Antenna 13.

PROJECTS

1. EVLA

Front End

The prototype L-Band receiver, with its newly designed octave bandwidth OMT, has been undergoing preliminary evaluation in the lab. The OMT design is extremely important because a scaled version of it will be used at S and C-Bands. While there are a few issues that still need to be addressed in the final design, the RF performance of the L-Band receiver was satisfactory enough to allow the Front End Critical Design Review to proceed as scheduled at the end of April.

Receivers and associated equipment continue to be installed on the EVLA antennas. The third EVLA Q-Band receiver was installed on Antenna 13 in February. It used 2 of the 6 MMIC-based 40-50 GHz post-amplifiers, which were successfully assembled in-house. An interim C-Band front end was also installed on Antenna 13, giving it a full complement of core receivers. Antenna 18, the 4th EVLA Antenna to be upgraded, received its L, C, X & K-Band systems by the end of March. Its Q-Band receiver is nearing completion in the lab. The F-Rack has been installed and the cable trays have been mounted in Antenna 24. The antenna's X-Band receiver has been prepared and will be installed in April.

First fringes were recorded at P-Band in March on Antenna 14. This experiment followed a concerted effort to eliminate the tendency for the commercial 327 MHz front end amplifiers to break into oscillation, often causing strong RFI to occur at C or X-Band.

In January, a novel test was performed on the VLA where four L-Band receivers were driven into compression in a controlled and systematic manner. The test simulated the effect of RFI on sensitivity, phase-closure, and image fidelity. Test results are being analyzed and will be reported in EVLA Memo 104.

Local Oscillator

The central reference generators (L350) are now in full production. The design for the new motherboard of the LO transmitter (L353) is underway and will be completed in the second quarter 2006. The L302 synthesizer has had some phase continuity problems, which are believed to be software-related. Significant progress has been made in troubleshooting the problems with the L302. The new analog boards that are used in many modules have been completed, and production quantities of the boards are being ordered. A new motherboard was made for the round trip phase measurement module (L352) and is undergoing tests before production board orders will be placed. Round trip phase testing is still on going and is expected to continue through the second quarter of 2006. The phase stability of the fiber round trip system is currently not meeting specifications and solutions are being investigated.

Fiber Optics

The Digital Transmission System (DTS) modules continue to be built to meet the antenna outfitting schedule. Antenna 24 is almost completely outfitted with fiber optic cable. Only the cables in the vertex room need to be spliced. The remainder of the fiber cables in the vertex room will be installed after the local oscillator and front end racks are installed.

PROJECTS

1. EVLA

In early January, the optical fiber cable on the west arm was accidentally cut while digging to repair a damaged water pipe. The cut affected seven of the EVLA pads on the west arm. Fortunately, there were no operational EVLA antennas on the affected pads. Two cables were cut: a 96 fiber cable and a 60 fiber cable. It took 115 man hours to repair and test the 156 fibers. An additional 21 man hours were required for trenching and burying the cables. The fiber group had made preparations for such an event a year ago by building Emergency Restoration Kits, which greatly helped with the repairs.

Intermediate Frequency

The housing for the UX converter (T303) is undergoing design changes because of RFI leakage. New housings for the UX converter are expected in the next quarter. The T304-305 down converter has new boards, which are currently undergoing tests. Modules with the new boards are being constructed and will be used in Antenna 18.

Correlator

Prototype correlator chips and the prototype baseline board are expected in June 2006. The requirements and functional specifications for the software needed to support prototype testing were expanded and clarified. The software is still on schedule.

A plan was developed for on-the-sky (OTS) testing of the prototype WIDAR correlator. The definition of the software needed to support OTS testing has begun. The actual OTS testing is scheduled to begin during the third quarter 2007. First testing of the final correlator is expected to occur in the third quarter of 2008.

Monitor & Control

Two major releases and one minor release of the User Interface software were issued during the first quarter 2006. The Array Operator screen now includes the ability to add or remove antennas during an observation. An interim Telcal program (ITelCal) became operational. It produces complex antenna gains and pointing offsets. Reference pointing and double reference pointing are now fully implemented for EVLA antennas. The ability to control VLA antennas from the EVLA Monitor and Control system is approximately 90 percent complete.

Development of the new correlator controller continues to progress. The controller is scheduled to be operational in the next quarter.

Data Management

Within the e2e group (now renamed to the Science Domain group), work in the past quarter has focused on the overall architecture, the Proposal Submission Tool (PST), and maintenance and enhancement of existing parts of the software system (the User Database, scheduling efforts, and the Archive).

PROJECTS

1. EVLA

With the addition of the final Science Domain employee, we are now in a position to competently address the question of the real implementation of the overall design. Issues of common structure of the various pieces of the system are starting to be addressed. Work on the overall design will initially focus on a number of internal "models" – descriptions of the fundamental components of the system that are integral to both the scientist interfaces and the internal operation of the system.

Our first foray into a prototype of a major component of the EVLA software system is the Proposal Submission Tool for the VLA and GBT. This will be modified to support the EVLA, and the ability to support a number of telescopes is naturally built into the tool. In closely related work, the Proposal Handling Tool will have its initial version released in the next quarter.

Work on the User Database and its interface into the rest of the system continues. This is a significant part of the "glue" that holds the system together.

Work on the Observation Preparation Tool has just begun. A very preliminary version exists now, and a clear plan to incorporate VLA support into the tool exists (by the end of 2006).

Work on the Scheduling Tool is mainly concentrated on a prototype that is being used to schedule the VLA during moves between configurations. The knowledge gained from these experiments on the prototype is being incorporated into the model development for the overall architecture.

The current VLA archive access tool is a very successful prototype for the eventual EVLA archive access tool. Continued support of this tool is of vital importance to the development of our final archive access tool.

Post-processing effort has focused on algorithm development and user interface tests. In the upcoming quarter there will be intensive tests on some of the new algorithms and some new calibration tests to verify that CASA will work on EVLA data. We are currently investigating whether EVLA and ALMA can use a common Science Data Model (SDM) – this will be an important issue both for post-processing and for other elements of the EVLA software system.

2. NEW INITIATIVES

The New Initiatives Office (NIO) at NRAO does not include any staff other than the Division Head, but tries to coordinate the activities of scientific and engineering staff from other NRAO divisions who are working on various planned new activities, many of which involve collaboration with other national and international groups.

The Square Kilometre Array

Various NRAO staff members are working with the International SKA Steering Committee (ISSC), the International SKA Project Office (ISPO), and its Working Groups and Task Forces to further develop the SKA concept.

The NRAO hosted the bi-annual meeting of the ISSC in Socorro NM during the period March 14-18. Activities included a Technology Day which was attended by some 75 people from universities, observatories, and industry, a meeting of the SKA Site Evaluation and Operations WGs, and a tour of the EVLA/VLBA, as well as the two day meeting of the ISSC.

Dick Thompson completed an extensive analysis of the recently formulated SKA "Reference Design." Craig Walker has completed a through study of proposed SKA configurations and has been asked to head this important Working Group.

Within the Observatory, we are discussing a number of challenging SKA development projects including the design and fabrication of a prototype high frequency receiver, the design and fabrication of prototype LO/IF systems, the evaluation of configurations for the SKA antennas, broad band signal transport and correlation, and wide field high dynamic range imaging algorithms. Many of these tasks have parallels in ALMA and the EVLA projects, but the absence of the EVLA-2 project and constraints of the NRAO operations budget may mean that much of the planned SKA work at NRAO will need to be deferred.

The Long Wavelength Array (LWA)

Recently, UNM has obtained major funding from DoD for the further development and initial construction of the Long Wavelength Demonstrator Array. Construction has started on the first station of the LWDA at a location on the VLA site. Further development of the antenna/rf system is being discussed with colleagues from NRL and UNM. A number of NRAO scientists and software and hardware engineers are engaged in LWA development as members of the project working groups. Much of this work is of benefit to both the NRAO and the LWA in areas of RFI mitigation, data acquisition capability, mutual coupling measurements in arrays, long distance data transmission, wide field imaging, and shared system design.

The Frequency Agile Solar Radiotelescope (FASR)

The NRAO has been told that the FASR Design and Development Proposal (DDP) proposal which was submitted to the NSF Atmospheric Division (ATM) of the Geosciences Directorate (GEO) will not be

2. NEW INITIATIVES

funded at the requested level of $1.5 M in FY06, but rather at $200K per year for five years. During FY06 FASR is developing an operations cost model, using some MRI project carry over funds, $100K of funds made available by AUI, the $200K from the NSF, and NRAO technical support at a level of about 1 FTE. However, it is anticipated that this will be the last year that NRAO/AUI will provide funds for the FASR project which will need to receive full funding from the NSF if it to be developed further.

Space VLBI

The Russian Astro Space Center (ASC) has contracted with Russian industry to fabricate a 1.3 cm receiver for RadioAstron using the space qualified 1.3 cm amplifiers built for the project by NRAO. The NRAO scientists are collaborating with scientists from the ASC in testing multi frequency synthesis software developed by the ASC and used to analyze a recent VLA observation of M87. This software which is needed for RadioAstron may have important applications to the analysis of VLA and VLBA data. Very recently, the Japanese space agency announced the development of VSOP-2 with a planned launch in early 2012 and government funding is expected shortly. Discussions have begun with Japanese colleagues about collaboration on spacecraft tracking and ground-based observing and correlation, but NRAO participation will depend on NASA support at least for the incremental costs incurred in supporting the mission.

Beam Forming Array Development

In collaboration with scientists from Canada, NAIC, and at ASTRON, NRAO scientists and engineers are discussing optimum beam forming array parameters (frequency, bandwidth, number of beams, etc.) that would be of greatest scientific benefit to NRAO users. While our initial emphasis will be for use on the GBT, the development of efficient BFAs also has potential application to the operation of the EVLA below 1 GHz, and later to the SKA. Two possibilities under consideration for the GBT are a pulsar search array at 1.7-2.3 GHz and an array for molecular line mapping somewhere between 5 and 10 GHz.

OPERATIONS

1. GREEN BANK OPERATIONS

GBT Milestones

GBT Antenna & Operations (Azimuth Track Project) Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Receive quotations and recommend awards	08/30/05	01/30/06	01/30/06
2. Receive AUI/NSF approvals and make awards	10/30/05	02/28/06	03/24/06
3. All components on site	03/30/07		
4. Begin track replacement field work	5/01/07		

Notes:
3. Components required to be on site one month before field work commences.
4. Measurements will be made this summer by the field work contractor and NRAO in preparation for the installation in the summer of 2007.

GBT Electronics Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Spectrometer LTA Redesign Decision Point	05/15/06		
2. GBT RFI Monitor Station Complete	09/01/06		
3. Q-Band Reeiver Upgrade Work Complete	10/01/06		
4. Ka-Band Receiver Upgrade Work	10/15/06		
5. Design/replace I.F. ODM Amps	02/01/06		02/01/06
6. Design/prototype I.F. power divider	05/01/06		
7. C-Band receiver: Design cryostat for 350 refrigerator	05/01/06		
8. C-Band receiver: Design integrated receiver package	10/01/06		

Notes:
1. Necessitated by design difficulties and changes in personnel, a reassessment of the GBT Spectrometer LTA redesign effort began and the intent is to have a clear path forward by mid-May.
5, 6. As part of a continuing effort to improve the GBT spectral baselines, amplifiers driving the fiber IF system were replaced with units assembled here using commercial MMIC devices, giving improved linearity and stability. An improved power divider for use in the common IF was designed and prototyped, providing more than 40dB of port-to-port isolation.
7, 8. As a test case, redesign of the C-Band front-end began, intending to increase the levels of integration to improve the spectral stability.

OPERATIONS

1. GREEN BANK OPERATIONS

GBT Mechanical Engineering & Central Shop Milestones

Milestones	Original Date	Revised Date	Date Completed
1. GBT RFI Antenna Mount Fabrication	04/14/06		
2. Solar Burst Antenna	04/14/06	06/30/06	
3. ALMA Cartidge Extender Suite	03/31/06	04/14/06	
4. EVLA L-Band Feed Towers (2)	06/02/06		
5. GB Test Dewar	04/14/06		
6. GBT Ka Reciever Upgrade	08/18/06		
7. Zpectrometer Electronics Crate	06/01/06		

Notes:
2. Solar Burst Antenna delayed pending design finalization by project managers.
3. ALMA Cartridge Extender Suite delayed by addition of phase II designs.
7. Zpectrometer electronics crate completion is dependent upon design finalization and approval by project scientist.

GBT Software & Computing Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Upgrade Physical Infrastructure (machines, compilers)	02/15/06		02/15/06
2. Release Spectral Line GFM Plugin	02/15/06		02/15/06
3. GBTIDL v2.0 with Flagging	03/31/06	04/15/06	
4. Attend Joint PST Meeting with ALMA/EVLA	04/28/06		
5. Implement Single Factor (Weather Queue) Dynamic Scheduling Prototype	05/15/06		
6. Release Zpectrometer software	09/30/06		
7. Implement Multi-Factor Dynamic Scheduling Prototype	11/15/06		

Notes:
1. Major physical infrastructure changes supported, including the replacement of the machine vortex with gbtdata, and replacement of the DCR machine algol with tank.

OPERATIONS

1. GREEN BANK OPERATIONS

GBT Project Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Develop PTCS project milestones and plan for next two years	06/30/06		
2. Penn Array Receiver Full Lab integration at Penn	09/06/04	05/2006	
3. Penn Array Receiver GBT Commissioning	02/21/05	10/2006	
4. Zpectrometer Installed on GBT	10/01/06	10/01/06	
5. Zpectrometer Science validation complete	05/31/07	05/31/07	

Notes:
1. Planning for a reinvigoration of the PTCS project is in progress, setting priorities and plans according to the available resources.
2, 3. Penn Array Receiver progress has been slowed due to difficulties in fabricating the detector array.
4, 5. Zspectrometer is a collaboration with Andy Harris at University of Maryland.

2. NEW MEXICO OPERATIONS

VLA and VLBA Milestones

Management and Scientific Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Full Proposal Tool Release for VLA	09-01-05	01-05-06	01-10-06
2. VLA-VLBA Proposal Deadline	02-01-06		02-01-06
3. Decision on Outfitting VLA with 190 MHz Systems	08-05-05	02-01-06	02-07-06
4. Global cm VLBI Session	03-09-06		03-09-06
5. Host International SKA Steering Committee Meeting	03-17-06		03-17-06
6. Completion of VLA Archive Imaging Pilot Project	01-31-06	04-30-06	
7. Release of new version of Proposal Tool	05-10-06		
8. Host NRAO Users Committee	05-18-06		
9. Return Antennas 14 and 16 to operational VLA	05-20-06		
10. VLA-VLBA Proposal Deadline	06-01-06		
11. Aperture Synthesis Imaging Summer School	06-20-06		
12. VLBA Conversion to Full-Time Mark 5 Operations	03-31-06	06-30-06	
13. VLA-VLBA Proposal and Large Proposal Deadline	10-02-06		
14. Retire VLA Modcomp Computers	03-31-06	12-31-06	
15. AIPS 31DEC06 Frozen; 31DEC07 Released	12-31-06	12-31-06	

Notes:
6. Final report delayed; will feed into decisions of new e2e operations group.
12. Awaiting receipt of enough disk modules to support operations without tape backup.
14. Competing with EVLA software development and checkout, which take higher priority. Modcomp retirement by end of 2006 is required to eliminate annual service contract.

Computer Infrastructure Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Migration to Windows 2K domain	07-31-05	01-31-06	01-15-06
2. Upgrade VLA-PT link to T1	02-28-06		02-15-06
3. Bring up Antenna 18 EVLA MC network	10-15-05	01-15-06	03-05-06
4. Upgrade all NRAO-NM Linux machines to Redhat Enterprise 4	12-31-05	04-30-06	
5. Phase 2 of renumber AOC IP address space	02-28-06	04-30-06	
6. Host NRAO wide system administrator meeting	04-30-06		
7. Generate AOC-VLA link upgrade plan	05-30-06		
8. Bring up Antenna 24 EVLA MC network	05-30-06		

2. NEW MEXICO OPERATIONS

Notes:
4. In progress, approximately 90 percent done, AIPS and ALMA issues have been resolved and progress has resumed.

Operations Software Support Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Modify JObserve for 2006 leap second	03-31-06		01-05-06
2. Correlator controller operational by Modcomps	04-04-05	06-30-06	
3. Correlator controller operational by EVLA monitor and control	04-04-05	06-30-06	
4. Transcribe VLA observe-system files	11-30-02	01-31-07	
5. Translate and copy stored VLA monitor data format from 9-track to DAT	03-01-04	06-30-07	

Notes:
4. Low priority
5. Low priority

Electronics Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Replace the K-Band Receiver at VLA-17	01-11-06		01-11-06
2. Replace the X-Band Receiver at VLA-14	01-11-06		01-11-06
3. Replace the L-Band Receiver at NLVLBA	01-18-06		01-18-06
4. Install ten Mark-5 playback units in Socorro Operations	01-18-06		01-18-06
5. Remove the tape recorders at BRVLBA	01-18-06		01-18-06
6. Test replacement fuses at PTVLBA	01-31-06		01-31-06
7. Install single motor FRM rotation system at BRVLBA	01-18-06		02-07-06
8. Upgrade VLBA FRM system and replace focus motor at PTVLBA and complete evaluation	01-31-06		02-15-06
9. Scheduled Maintenance Visit SCVLBA	04-30-06		Cancelled
10. Scheduled Maintenance Visit KPVLBA (ACU Upgrade)	06-30-06	05-22-06	
11. Install multi-turn FRM Encoder at PTVLBA	07-14-06		
12. Scheduled Maintenance Visit MKVLBA (ACU Upgrade)	07-30-06	07-26-06	
13. Upgrade the TAC and Servo Boards at MK	07-30-06		
14. Scheduled Maintenance Visit HNVLBA (ACU Upgrade)	09-30-06		

2. NEW MEXICO OPERATIONS

Engineering Services Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Complete A array reconfiguration	02-03-06		02-03-06
2. St Croix VLBA antenna structural inspection	02-15-06		02-03-06
3. Refurbish 2 railroad ballast cars	04-30-06		02-03-06
4. 1984 MC9 Coach Engine Rebuild	02-15-06		02-15-06
5. LWDA site preparation	03-03-06		02-15-06
6. Update VLA Electrical Distribution Drawings	03-31-06		03-09-06
7. Remove and inspect 6 different transporter axles	03-30-06		03-22-06
8. Complete firehouse building	03-30-06		03-23-06
9. C and D array transformer PMs	11-30-05	03-31-06	03-30-06
10. Complete Antenna 26 Bearing Change (non EVLA)	08-24-06	05-05-06	
11. Complete BnA array reconfiguration	05-26-06		
12. Complete B array reconfiguration	06-16-06		
13. Adapt VLBA digital tachs to VLA	03-31-06	06-30-06	

Archive Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Install ESO-ALMA NGAS Archive Hardware prototype	03-15-06	04-03-06	
2. Construct Image Server as part of the current NRAO Science Data Archive	05-15-06		
3. Acquire-Install ESO-NGAS Archive Software	05-15-06		
4. Acquire and install GBT science data in NRAO Science Data Archive (1.5 Tbytes)	06-01-06		
5. Integrate NGAS Archive System in to NRAO Science Data Archive	08-15-06		
6. Construct global calibrator source database and user tools for all NRAO telescopes: ALMA,GBT, VLA-EVLA, VLBA	12-31-06		
7. Refactor NRAO Science Data Archive servlets	12-31-06		
8. Complete copy of historical VLBA tape archive to on-line archive disk array	12-31-06		

2. NEW MEXICO OPERATIONS

NVO Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Planning for near-term NRAO archive/VO work			01-30-06
2. Internal review of NRAO archive/VO plan as presented to NSF	01-25-06		01-25-06
3. External advisory committee review	02-16-06		02-16-06
4. Initial planning for 3rd annual NVO Summer School	04-15-06		
5. Draft SSA 1.0 interface	05-01-06		
6. SIA 1.1 planning for May IVOA interop	05-12-06		
7. Initial draft spectral line list interface	05-12-06		
8. IVOA interoperability workshop (Victoria BC)	05-15-06		
9. Scalable data analysis framework prototype	06-12-06		
10. NVO/Opticon data analysis frameworks workshop	06-13-06		
11. NVO Summer School (Aspen)	08-06--06		

AIPS++

CASA

The key activities for this cycle were the system work in support of the framework migration, development for the SS16 release, the ALMA R3.1 development, EVLA high dynamic range imaging development and preparation, deployment and support for the ALMA2006.01-4 test (single baseline ATF simulation).

- *SS16 http://projectoffice.aips2.nrao.edu/ss16.html*
  - uv model fitting (point source, gaussian, disk; single component)
  - calibration plot and editing utilities
  - visibility plotting, editing and averaging facilities
  - baseline-based calibration (gain and bandpass)
  - fringe fitting calibration (baseline-based)

Highlights

- ALMA2006.01-4
  First Deployment of CASA (beta) for ALMA2006.01-4 test. Demonstrations of CASA as it was developed, were provided to the NAUG scientists. The NAUG scientists also engaged in several rounds of pre-testing to refine the tools and documentation (Brisken, Owen, Myers, Rupen, Shepherd, Whysong).

  http://projectoffice.aips2.nrao.edu/ALMA2006.01/ALMA2006.01.html

2. NEW MEXICO OPERATIONS

- CASA
  - New framework with IPython interface, Python scripting, and matplotlib general plotting facilities.
  - Tools ported: calibrator, imager, ms, msplot (new), tableplot (new) calplot (new), autoflag (partial), measures (partial), tables (partial).
  - Initial migration of several ASAP (single dish) applications.
  - RPM distribution to testers.
  - Progress on task/parameter system;
  - Reviewed at week-long CASA User Interface Charette (report due in April).

- *ALMA Optical Pointing Use Case*
  Support was provided to this Focus Group to provide simulated data sets (to enable TelCal to initiate work earlier in the schedule), an archive submission and retrieval tool, an ASDM table browser and an ASDM data repository for easy cross-subsystem access.

- *ALMA Data Capture support for ALMA Telescope Data Model (ATDM)*
  This was done in collaboration with the Control and Correlator subsystems; support for filling optical pointing data sets (non-correlator) for the Optical Pointing group.

- *ASDM filler*
  Extensive work unifying the correlator and offline content for binary headers. Revised ASDM data sets were produced. A revised filler was used to translate these into Measurement Sets for post-processing analysis.

- *EVLA memo #100*
  "Correction of Errors Due to Antenna Power Patterns During Imaging" -- Bhatnagar, Cornwell, Golap.

- *URSI presentations: http://cires.colorado.edu/ursi/2006/program.html*
  - Bhatnagar - "Full Beam Imaging at High Dynamic Ranges"
  - Rao-Venkata - "Wide-Bandwidth Imaging: Challenges and Prospects for the EVLA and Beyond."

- *ALMA Offline Release 3.1*
  http://almasw.hq.eso.org/almasw/bin/view/HLA/ReleaseR3dot1Deliverables

- *Port of ALMA Offline subsystem to ACS 5.0 and RHE4.*

2. NEW MEXICO OPERATIONS

Goals for the Second Quarter 2006

1. ALMA CDR4 documents
2. EVLA2006.07-2
3. EVLA Development Planning update/Test plan update
4. CASA functionality: images, measures, autoflag,
5. Review and development actions from ALMA2006.01-4 report
6. Review and development actions from User Interface Working Group report.
7. Qt stand-alone viewer
8. Stable SS17 release

3. NA ALMA Science Center

Completed NAASC Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Present at ALMA Town Meeting at January AAS.	01-09-06		01-09-06
2. Host first NAASC Science Workshop "From z-Machines to ALMA: (sub)Millimeter Spectroscopy of Galaxies".	01-14-06		01-14-06
3. Post AAS talks, z-Machine talks to NAASC website	02-21-06		03-16-06
4. ANASAC meeting (main topic: ASAC report).	02-24-06		02-24-06
5. Submit NAASC articles for April NRAO Newsletter (post to web)	03-01-06		03-01-06
6. Hold status/planning meeting for spectral line/calibrator database.	03-16-06		03-16-06
7. Participate in ALMA Offline user test (J. Mangum).	Mar 1 – Mar 31		03-25-06
8. Participate in ALMA Pipeline test (E. Fomalont, J. Hibbard).	Mar 13-Apr 6		04-06-06
9. Participate in GUI user focus group (E. Fomalont, C. Brogan, J. Hibbard; in Socorro NM).	Mar 27-31		03-31-06

NAASC Milestones for 2006 Q2 (April-June 2006)

Milestones	Original Date	Revised Date	Date Completed
1. Generate new WBS for 2006-2013 for internal review	04-01-06		
2. Generate new "NA ALMA Ops & NAASC" draft (v0.5) and post with supporting material on website, for review committee	04-04-06		
3. Submit Quarterly Report	04-07-06		
4. Hold review of NA ALMA Ops & NAASC plan	04-11-06		
5. Generate NAASC document for Visiting Committee Meeting (April 17-18 in GB)	04-07-06		
6. NAASC presentation to Visiting Committee	04-18-06		
7. NAASC presentation to NSF	04-24-06		
8. Generate NAASC document for users committee meeting (May 17-18 2006 in Socorro)	04-28-06		
9. ANASAC meeting (agenda; close open items)	04-24-06		
10. NAASC organizational meeting	05-03-06		
11. Submit AAS proposal for ALMA Town Meeting at next winter AAS meeting	05-15-06		

3. NA ALMA Science Center

Milestones	Original Date	Revised Date	Date Completed
12. NAASC presentation to Users Committee	05-17-06		
13. Organize SOC/LOC for 2nd NAASC workshop on astrophysical disks and Astrochemistry	05-30-06		
14. Generate revised NA ALMA Ops & NAASC draft, incorporating comments from review, VC, NSF, UC meetings.	06-01-06		
15. Generate poster on NAASC, splatalogue, ALMA Level-1 science goals for Calgary AAS meeting	06-01-06		
16. Submit articles for July 1 NRAO Newsletter	06-05-06		
17. Attend Calgary AAS meeting; ALMA special session June 5; posters June 7-8	June 5-8 2006		
18. Revise ALMA Operations Plan (with project scientists, project managers, ARC managers, JAO) for next Board meeting	06-30-06		

Longer term NAASC Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Spectral line catalogue – continue resolving species (135/677 resolved as of 4-01-06)	On-going		
2. NAASC proposal to NSF	09-30-06		
3. Offline software test 2006.10-6	10-30-06		
3. Develop plans for 2007-2009 based on construction milestones. What staff/software/documentation must be in place by when?	Draft by end of summer (08-31-06)		
4. Plan 2nd NAASC workshop	Fall		

4. Central Development Lab

Amplifier Design and Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Evaluation of TRW Cryo-3 devices from the point of 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 covering frequency range from 1 to 120 GHz	04-01-04	12-31-06	

Notes:
2. A redesign of 4-8 GHz amplifier to achieve a better dynamic range has been completed and the prototype has been successfully tested. A redesign of 18-26 GHz and 26-40 GHz amplifiers to improve gain is proceeding.

Other Projects: A theoretical effort to develop a noise model of heterostructure bipolar transistors (HBTs) applicable at cryogenic temperatures for both SiGe and InP technologies has resulted in a paper to be published at MIKON2006 Conference titled "On Certain Noise Properties of Field-Effect and Bipolar Transistors". Also, the results of a study to understand better the noise performance of MOSFET's will be presented in the talk to be delivered at IMS 2006 Workshop WSE-142 "Noise Measurement and Modeling for CMOS". This talk is titled "Modeling of Noise in Three Terminal Microwave Devices (Circuit Theory Approach)".

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	12-31-2015		
2. Build/upgrade/repair cryogenic amplifiers using Cryo-3 TRW devices for VLBA, GBT covering frequency range from 1 to 95 GHz	ongoing		
3. New amplifier test system development	06-30-2006		

Notes:
1. First quarter production totaled 18 new and upgraded amplifiers. This included three low noise L-Band, five high dynamic range L-Band, two C-Band, and three Q-Band amplifiers. Six C-Band chassis were machined, prepared and plated.
3. Replace the ~25 years old Apple II/ADIOS amplifier test system with the new PC/ Labview system. Significant progress was made in configuring the new PC based noise test set with porting of the ALMA – Labview software to the new machine, testing of the 488 controlled instrumentation and noise diode controller.

4. Central Development Lab

Other Projects: The Chemical Lab plated approximately 45 grams of gold, mostly in support of ALMA construction. That represents a gold value of about $900 and an estimated job cost of $13,000 if done commercially.

Superconducting Millimeter-Wave Development Milestones

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

Notes:
1. Work has focused on optimizing the parameters of this process prior to fabricating tunnel junctions. This project is being done with the University of Virginia Microfabrication Laboratory
2. The first wafer of hybrids has been completed at the University of Virginia Microfabrication Laboratory and the first devices are now being tested at 4 K. Preliminary results are shown in Figure 1. This work is being funded in part by the Arizona Radio Observatory of the University of Arizona. The results will be presented at the International Symposium on Space Terahertz Technology and at the Applied Superconductivity Conference later this year.
3. This is a joint project between NRAO and the University of Virginia Microfabrication Laboratory and was supported mainly by UVA through an NSF grant. Development of the junction fabrication process at UVML and the design of the mixer block have been suspended due to the lack of funding and manpower. We hope that this project will be able to be continued in the next quarter.
4. This is a collaborative project of the NRAO-CDL and Prof. Robert Weikle of the UVA Department of Electrical and Computer Engineering.

Other Projects: Repaired a 68-90 GHz SIS mixer for the Arizona Radio Observatory of the University of Arizona.

4. Central Development Lab

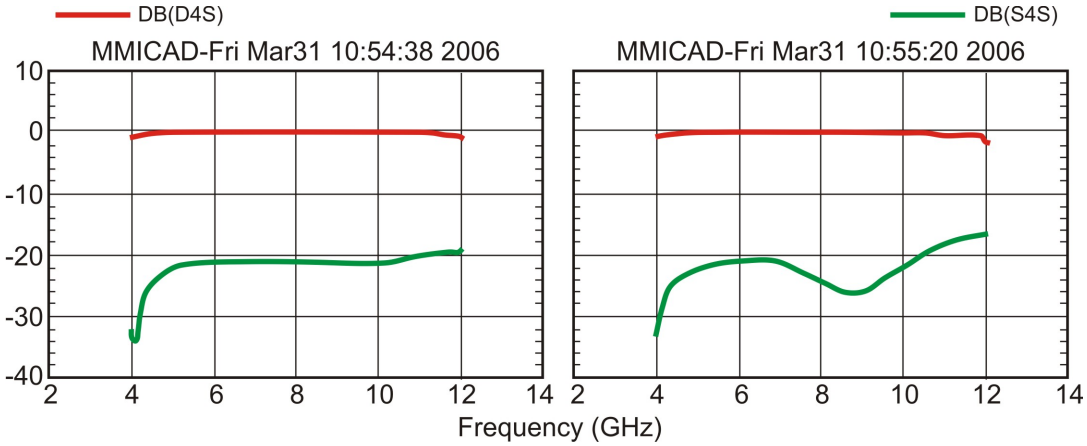

Figure 1. Measured (right) and simulated (left) characteristics of the 4-12 GHz superconducting 180° hybrid. The upper (red) curves indicate the coupling (dB) from the mixer ports to the IF amplifier port when the signals at the mixers are out-of-phase (e.g., the downconverted signal from the sky in a balanced mixer), and the lower (green) curves show the same quantity when the signals at the mixers are in-phase (e.g., the downconverted LO sideband noise in a balanced mixer).

Electromagnetic Support Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Design of EVLA Ku-Band feed	09-30-04	09-30-06	
2. Develop dual frequency 300/600 MHz feed for the GBT	09-30-05	06-30-06	
4. Measure EVLA S-Band prototype feed	06-30-06		

Notes:
Other Projects: The GBT beam at 1.4 GHz was recalculated in several cuts using 72 phi cuts of the subreflector scattered pattern. The subreflector scattered pattern calculated by the NEC-Reflector code is about the axis of the ellipsoidal reflector. To estimate the spillover past the main reflector, the subreflector patterns were calculated about the axis from prime focus to the center of the main reflector. This computation was done outside the NEC-Reflector code.

4. Central Development Lab

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

Milestones	Original Date	Revised Date	Date Completed
GB/SRBS Phase II:			
1. 70-300 MHz, dual polarization, log-periodic on 45-foot telescope, new analog spectrometer	03-31-05	05-15-06	
GB/SRBS Phase III:			
2. 10-80 MHz, dual polarization, four crossed dipoles, new digital spectrometer	09-30-05	06-30-06	
3. 80-300 MHz, dual polarization, log-periodic on 45-foot telescope, new digital spectrometer	09-30-05	06-30-06	
4. 300-2500 MHz, dual polarization, 45-foot telescope with log-periodic feed, new digital spectrometer	09-30-05	09-30-06	

Notes:
1. Fabrication has been delayed due to personnel shortage in the Green Bank machine shop.

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

Milestones	Original Date	Revised Date	Date Completed
1. Four portable sleeved-dipole elements	09-15-05		09-15-05
2. Eight-element, full-Stokes array in Green Bank	03-31-06	06-15-06	
3. 32-element prototype array, operating in the 100-200 MHz band in Green Bank	12-31-06		
4. Submit proposal for the larger array in Western Australia	11-15-05		11-15-05

Notes:
4. The proposal to support efforts for the larger array in Western Australia was submitted to the NSF AST Grants Program.

This is a collaborative project of the NRAO-CDL, UVA Astronomy Department and the Radio Astronomy Laboratory at UC-Berkeley to measure the predicted step in the cosmic background amplitude due to neutral hydrogen at the Epoch of Reionization. A 32-element prototype array, operating in the 100-200 MHz band, is being developed for deployment in Green Bank. Its primary purpose is to investigate systematic errors and explore wide field-of-view imaging techniques in preparation for a larger array being planned for Western Australia to study the Epoch of Reionization. In addition, the Green Bank array may also be used to explore element configurations for the Frequency Agile Solar Radiotelescope (FASR) project, as a component of the Green Bank Solar Radio Burst Monitor, as a hands-on educational tool for the NRAO-UVA Instrumentation Program, and as a component of the NRAO public outreach program. At present, the array consists of four portable sleeved-dipole elements on ground screens that

4. Central Development Lab

are connected to a central correlator via coaxial cable. The dipoles, active baluns, transmission line drivers, and receivers were developed by students at the NRAO-UVA Instrumentation Program. The Berkeley group is developing the wideband correlator, with a four-channel prototype version currently deployed in Green Bank. Both groups are participating in data reduction and analysis. The next step, an eight-element, full-Stokes array in Green Bank has been partially deployed and will be completed in mid-June 2006. Completion of the 32-element array is scheduled for winter, 2006.

FASR Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Develop FASR engineering R&D planning document	04-28-2006		
2. Develop FASR engineering design document	06-16-2006		

Notes:
2. This will be a dynamic document that will be updated periodically to incorporate the latest results from the R&D work.

A FASR Development Workshop was held in Charlottesville on February 9-10 for the purposes of refining the scientific objectives for the instrument, translating these objectives into engineering requirements, and exploring various design alternatives. The Workshop was largely successful in providing the necessary framework for the project design work to proceed.

In mid-February, Bradley agreed to serve as interim project engineer. A task group consisting of Bastian, Bradley, Bryerton, Fisher, Gawande, Morgan, Saini, and Thompson was formed to begin addressing the design issues in detail. The team was tasked with two primary objectives: 1) design a functional FASR system from a low technical risk viewpoint, and 2) identify those areas of the system that would benefit from research and development. The task group meets on a weekly basis and significant progress has already been made toward meeting these objectives with the goal of completing the the FASR Engineering Design Document by June 16th.

Four areas in which the instrument's performance could be enhanced or its cost could be reduced through directed R&D initiatives have been identified. These include the FASR A / B front-end sub-systems (wide band feed and low noise amplifier), the wide bandwidth fiber optic transmission sub-system, the frequency conversion sub-system, and the basic station configuration for FASR C. The task group is currently planning the R&D activities with the goal of completing a FASR Engineering R&D Planning Document by April 28.

OPERATIONS

5 CHILE

Local Labor Milestones

Milestones	Original Date	Revised Date	Date Completed
1. NSF-ESO agreement on Local Labor	01-10-06		01-10-06
2. ALMA Human Resources Head vacancy notice	03-19-06		03-19-06
3. Local Staff Internal Rules & Regulations - submitted	03-31-06		03-31-06
4. Compensation Package (wage and benefits scales and procedures) - submitted	03-31-06		03-31-06
5. Local Labor Conflict Resolution Procedures - submitted	03-31-06		03-31-06
6. Reference sample contracts - submitted.	03-31-06		03-31-06

Notes:
1. Agreement that AUI/NRAO will hire all local employees for ALMA in Chile on behalf of the project. AUI/NRAO to propose Internal Regulations, Wages and benefits, etc. Expected number of new NRAO-Chile (ALMA) employees approaches 150.
2. ALMA HR is a Key Personnel appointment to be approved by ALMA Board. Reporting lines to ALMA Director and NRAO's Head of HR.
3., 4. Submitted by AUI/NRAO to an ad-hoc working group including ESO and NAOJ.
5., 6. To AUI-Washington and U.S. lawyers.

Business/Contracting Milestones

Milestones	Original Date	Revised Date	Date Completed
1. OSF Catering Services Contract with Sodexho in effect	03-01-06		03-01-06
2. OSF Cleaning Services Contract with Sodexho in effect	03-01-06		03-01-06
3. Invitation for Bid. AOS TB HVAC Equipment	02-21-06		02-21-06
4. Completion of grading at VERTEX Site Facility	02-09-06		02-09-06
5. Completion of grading at ACA Site Facility	03-30-06		03-30-06

Notes:
1., 2. Now under NRAO's responsibility
5., 6. For antenna foundations at OSF, in support of Antenna Integration & Verification.

OPERATIONS

5 CHILE

Other Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Submission of Annual report to Ministry of Land	03-31-06		03-31-06
2. Call for proposals to ALMA-CONICYT astronomy Fund	02-17-06		02-23-06
3. Submission of proposal for Chile EPO, as well as Technical and Scientific Collaboration with Chile to NRAO.	02-03-06		02-03-06

Notes:
1. Formally submitted by Radio Astronomy Chajnantor Ltd. (RCL), the Company formed by AUI and ESO to receive the Chajnantor land from the Ministry of Land. Annual report maps ALMA progress for confrontation with plan approved by Chilean authorities.
2. Open to Chilean scientists and engineers. As of this year it includes Japan's contribution.

6. Computer and Information Services

Observatory-wide Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Kiosk machines for Employee Self Services deployed (b)	01-01-06		12-30-05
2. New email quarantine service fully deployed (b)	01-31-06		01-17-06
3. Migration of Windows systems to AD domain complete (b)	07-31-05	01-31-06	01-31-06
4. Deployment of Google mini for searching internal web pages (c)	03-31-06		03-21-06
5. Decide on technology for personal video deployment (d)	03-31-06		03-29-06
6. System administrators meeting in Socorro (b)	04-25-06		
7. Begin new CCE coordination for Apple OS/X (b)	04-25-06		
8. Upgrade of main web server in Charlottesville (c)	03-31-06	05-31-06	
9. Migration to RedHat Enterprise Linux 4 complete at all sites (b)	05-31-06		
10. Upgrade of Google Mini search engine (c)	05-31-06		
11. Deployment of Symantec Anti-virus version 10 (a, b)	07-31-06		
12. Deploy new central Ethernet hub in Green Bank (d)	07-31-06		

Notes:
3. This has already been declared complete at sites other than New Mexico; it is now complete there, too.
8. Migration of content to the new web server for Charlottesville was largely completed this quarter. Some necessary software upgrades to the wiki and mailing list components of the server caused a delay in transitioning to the new hardware.

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

Charlottesville Computing Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Migration of support for Tucson employees to CV	02-28-06		02-26-06
2. Upgrade of central utility Unix server (polaris)	02-28-06		02-26-06
3. Order computers for summer students	04-15-06		
4. Upgrade of central disk filer	04-15-06		
5. Migration to RedHat Enterprise Linux 4 complete	05-31-06		
6. Windows administrators at security training (6 days)	06-30-06		

7. Education and Public Outreach

Publications Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Brochure task kick-off meeting	02-15-06		02-15-06
2. Brochure concept review with the Director	02-17-06		02-23-06
3. EPO review of 1st draft general public brochure	03-01-06		03-01-06
4. EPO review of 2nd draft general public brochure	03-15-06		03-15-06
5. Deliver April Newsletter issue to printer	03-17-06		03-24-06
6. Issue submissions call for July Newsletter	05-01-06		
7. General public brochure delivered by printer to NRAO	05-26-06		
8. Astronomical community brochure delivered by printer to NRAO	07-28-06		

Notes:
1. EPO is designing and writing two new Observatory-wide brochures. The first targets the general public; the second targets the astronomical community.
2. Delayed by Director's travel schedule. No impact to delivery dates.
5. Delayed by desire to include breaking news of key personnel hires. Delayed delivery to subscribers by one week. No significant impact.

World Wide Web Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Submit potential vendor list	03-07-06		03-06-06
2. Final Discovery Statement of Work review	03-07-06		03-07-06
3. Discovery RFQ ships to potential vendors	03-17-06	03-23-06	03-27-06
4. Proposal deadline	04-24-06		
5. Contract award notification	05-12-06		
6. Vendor period of performance starts	05-24-06		
7. Vendor period of performance ends	07-07-06		

Notes:
3. This Request for Quote (RFQ) seeks to engage a vendor to work with NRAO personnel in the generation of a detailed scope of work, budget, and schedule for renovation of the Observatory's web site. Additional time was required to determine appropriate contractual Terms & Conditions.

7. Education and Public Outreach

ALMA EPO Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Submit initial NAASC Ops & Staffing Plan input	03-26-06		03-26-06
2. Internal NAASC Ops & Staffing Plan Review	04-11-06		

Notes:
1. EPO is working with North American ALMA Science Center (NAASC) and ALMA Construction Project personnel to define a long-term ALMA EPO plan. This plan will be extensively discussed at an internal review of the draft NAASC Operations & Staffing Plan on April 11.

Astronomical Community Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Winter AAS meeting exhibition ends	01-12-06		01-12-06
2. Initiate IAU General Assembly planning	01-17-06		01-17-06
3. Submit IAU General Assembly exhibit request	02-15-06		02-12-06
4. Submit summer AAS meeting exhibition request	04-19-06		
5. Summer AAS meeting exhibit ends	06-08-06		

Notes:
1. Three re-designed exhibits—NRAO Operations, ALMA, EVLA—debuted at this meeting. EPO also supported ALMA and EVLA Town Meetings, and organized a press conference and press reception.
3. EPO will design and staff two exhibits at this IAU: an international ALMA exhibit coordinated with NAOJ and ESO (lead); and a NRAO exhibit (GBT, VLA / EVLA, VLBA) organized internally.

Management Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Annual EPO planning meeting	04-27-06		
2. Users Committee briefing	05-19-06		

Notes:
1. The annual EPO planning meeting will take place in Green Bank, April 27-28. This meeting will produce an initial program and budget for a proposed FY 2007 EPO program, including milestones and deliverables.

MANAGEMENT

1. Administration

Environment, Safety, and Security

This quarter, the ALMA Safety Manual was approved and posted. Efforts are now underway to implement the program. In New Mexico, ES&S led the efforts to recertify the Array Operations Center halon fire protection system. At the VLA, ES&S led the development of a Department of Transportation drug and alcohol testing program for commercial drivers. At Green Bank, ES&S focused on completion of the annual hazard communication program. Also, the annual fire alarm and smoke detection inspection was conducted. In Charlottesville, the site life safety program was initiated with the installation of smoke detectors. Future efforts include the schedule for environmental items that were identified in the full site audit.

ALMA

This quarter, the ALMA Safety Manual was approved and posted on the ALMA Electronic Data Management system. ES&S developed working agreements for the Chajnantor Working Group (CWG) which represents the many projects with interest in radio astronomy in the Chajnantor Plateau and the nearby science preserve.

NRAO-New Mexico

In New Mexico, ES&S pursued the recertification of the Array Operations Center halon fire protection system. An inspection was completed and outstanding items identified that are necessary to ensure proper operation of the suppression system. At the VLA, ES&S made significant efforts toward the development of a Department of Transportation drug and alcohol testing program for commercial drivers. It is anticipated that the complete safety program for the drug and alcohol testing will be completed within the next quarter.

This quarter, the VLA site was visited by the New Mexico division responsible for the proper maintenance and operation of above ground storage tanks. Several minor deficiencies were identified and efforts are underway to correct the issues.

This quarter also increased awareness of a potential overcrowding issue at the AOC. ES&S has taken steps to identify and assure safe egress from the first floor laboratory area. Actions taken include the identification of proper egress routes and the development of restrictions to prevent encroachment on emergency routes.

NRAO-Green Bank

This quarter, ES&S focused on completion of the annual hazardous materials identification program. This included the completion of the MSDS files associated with the new products in use at the Green Bank facility. In addition, the ES&S staff reviewed the vehicle safety inspection program which covers the site vehicles as well as the roadworthy autos. Lastly, the annual fire alarm and smoke detection inspection was conducted. This includes a full site review of the fire protection system.

1. Administration

NRAO-Charlottesville

In Charlottesville, significant advancement was achieved in the addition of fire and life safety devices at the NTC facility. This included the installation of local fire detectors and a review of the fire extinguishers.

Future Efforts

The environmental audit was conducted for all sites and the results were obtained. The results are currently in review and within the next quarter, a plan will be developed to address any outstanding deficiencies.

2. Program Management Office

Since this Program Management Office (PMO) chapter is a new addition to the NRAO Quarterly Report, some background information is provided below regarding the role of the PMO at the Observatory and the status of principal initiatives.

Role of Program Management Office

The Program Management Office (PMO) provides Observatory-wide program management support across all domains of Observatory projects including telescope construction, hardware and software development, MIS, and IT infrastructure.

The initial charter for the PMO, as directed by AUI and NRAO senior management, contained three broad based goals:

1. Modernize the NRAO business services and systems,
2. Integrate effective project management controls across all Observatory projects, and
3. Participate in the planning of new Observatory programs.

While not a traditional role of a program management office, the NRAO PMO is leading the modernization of Observatory business services and systems. The objectives of this effort are to improve the accuracy and timeliness of all business information, to provide the foundation for program management controls, and to reduce administrative effort of these business services over the long term. To successfully accomplish this effort will require the participation of key stakeholders across all divisions and programs of the NRAO.

The integration and utilization of program management controls is the primary role and responsibility of the PMO. This effort will provide the mechanisms and metrics to perform assessments of all Observatory programs; the capability to monitor budget, cost, schedule, and risk of Observatory programs on a monthly cycle; and the early warning triggers to engage with NRAO project and program managers to launch mitigation strategies that maintain the critical path of these programs.

The modernization of the NRAO business systems was translated into a detailed plan by the PMO called the *Web Based Business Services (WBBS) Initiative*. This initiative requires a multi-year implementation phase for the design and deployment of the business services as well as a major architecture upgrade to meet the performance requirements of the Observatory.

The integration of effective project management controls across all Observatory projects was translated into a detailed plan by the PMO called the *Performance Based Project Management (PBPM) Initiative*. This initiative also requires a multi-year implementation phase to establish the processes, systems, personnel, metrics, and best practices required for effective project management.

2. Program Management Office

PMO Status

WBBS Status

The primary focus of the PMO over this past quarter has been on the development of the NRAO Web-Based Business Services. Figure 1 shows the decomposition for the eight major business services of the Observatory. The Web Based Business Services (WBBS) Initiative provides the following eight (8) major NRAO business services: Property Management, Travel, Procurement, Fiscal, Human Resources, Payroll, Employee Self Services, and Electronic Time Keeping.

Each service can be decomposed into subsystems, features, and functions. For example, the Fiscal Business Service is composed of the following subsystems: General Ledger, Accounts Receivable, Accounts Payable, and Job Cost. Analysis of NRAO business services identified that within the eight major business services that 59 significant functions required upgrade.

Of the eight services, Procurement followed by implementation of Fiscal, Human Resources, Payroll, Employee Self Services, and Electronic Time Keeping were determined as the highest priorities and consequentially planned for implementation, and deployment during calendar year 2005 and first quarter of calendar 2006. The majority of services are all in operation. The Electronic Time Keeping Service is near completion. The following table provides the status and Go Live date of the WBBS services.

WBBS Services Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Procure to Pay			05/16/05
2. Accounts Receivable			07/18/05
3. Architecture Upgrade			08/26/05
4. Accounts Payable			10/03/05
5. Job Cost			10/12/05
6. General Ledger			10/14/05
7. Human Resources			11/01/05
8. Employee Self Services			12/05/05
9. Payroll			01/09/06
10. Electronic Time Keeping		10/01/06	

A Web Based Business Services Modules review was held in March. The review was chaired by the Observatory Deputy Director. The review scope covered the currently deployed WBBS services including: Procure-to-Pay, Human Resources, Fiscal, Employee Self Services, and Payroll. Subject specialists and Presenters were established by the chair to support the review of each of the service modules.

2. Program Management Office

The review panel generated a report that provided significant feedback from the WBBS user community conveying concerns ranging across the spectrum of overall usability as compared to previous system(s), additional features needed, work flow concerns, expert user support concerns, and operations and maintenance support issues. Feedback was provided in the report in order of priority of concerns associated with each of the WBBS service modules. Open forums were also held to receive comments from staff on each module.

The Deputy Director, the Program Management Office, and Administration are currently working with the report panel members to understand the specific concerns and implement changes, and improvements wherever possible to resolve these issues. Further, other software Common off the Shelf (COTS) products are being assessed in a cost benefit trade-off to potentially address some of the limitations introduced by the current COTS product – PeopleSoft EnterpriseOne.

3. Personnel

	NEW HIRES	
Bone, Randall	Electronics Engineer II	03/27/06
Harland, David	Software Engineer I	02/01/06
Mansheim, Alison	Intern, Science and Academic Affairs	01/02/06
Remijan, Anthony	NRAO Post Doc	01/16/06
Rodriguez, Antonio	Quality Assurance Engineer II	03/20/06
	TERMINATIONS	
Debonis, David	Software Engineer I	01/27/06
Gibb, James R	Fiscal Officer	01/06/06
Heiderman, Amanda	Intern	03/03/06
Kovalev, Yuriy Yuryevich	Jansky Fellow	01/31/06
Nikolic, Bojan	NRAO Post Doc	02/24/06
	REHIRE	
Brogan, Crystal	Assistant Astronomer	03/06/06
Pokorny, Martin	Software Engineer I	03/13/06
	PROMOTIONS	
Hayword, Robert	Sr. Electrical Engineer	02/01/06
Kern, Jeff	Software Engineer II	03/01/06
Lucero, Sarah	Software Engineer II	03/01/06
Prestage, Richard	Assistant Director, GB Operations	02/01/06
	TRANSFERS	
Dyer, Paul	Scientific Associate III (to monthly status)	01/01/06
Murphy, Patrick	Senior Software Engineer	01/16/06
	OTHER	
McKinnon, Mark	Interim EVLA Director	02/01/06
Vanden Bout, Paul	Scientist/A, Senior (to part-time status)	01/01/06
Hibbard, John	Acting Head, NA ALMA Regional Center	01/01/06

4. Budget

The table below represents NRAO Operations (without EVLA) expenses and commitments for the first half of Fiscal Year 2006 as reported at Work Breakdown Structure (WBS) Level 1.

The available funds for NRAO Operations (without EVLA) total $48,800,359. This amount includes $41,960k in new NSF Funds ($47,400k less $5,440k for EVLA Phase 1 construction), $1,929,616 in prior year commitments, $902,208 in prior year operations carryover and $4,011,535 in Green Bank Track repair carryover. To date, $23,700k in new NSF funds for NRAO Operations has been received.

NRAO Operations Expenses and Commitments FY 2006 Year to Date (October 1, 2005 to March 31, 2006)

Work Breakdown Structure Element Level 1	Salaries & Benefits	Materials & Services	Travel	Revenue or Cost Recovery	Total
Observatory Management	$1,548,116	$1,339,805	$114,368	($18,801)	$2,983,489
Education and Public Outreach	$203,159	$110,981	$10,216	($72,166)	$252,191
Central Development Lab	$538,469	$197,382	$8,361		$744,211
Green Bank Operations	$3,634,723	$5,263,426	$53,948	($227,422)	$8,724,675
New Mexico Operations	$5,904,568	$2,191,429	$65,126	($47,511)	$8,113,612
ALMA Operations	$297,092	$54,106	$8,113	($6,065)	$353,246
Computer and Information Services	$424,926	$357,625	$7,427		$789,977
Division of Science and Academic Affairs	$1,861,924	$260,071	$92,770	($720)	$2,214,045
	$14,412,977	$9,774,826	$360,328	($372,684)	$24,175,447

ALMA CONSTRUCTION

The Joint ALMA office issues formal quarterly reports to the ALMA Board detailing the progress of the ALMA Project. It has been agreed with NSF that these reports will be the basis of future NRAO quarterly reports for the ALMA construction project. The latest JAO quarterly report is attached.

This report covers the period January—March 2006.

Status of NRAO ALMA Program Plan Objectives

The 2006 NRAO Program Plan set out a series of key objectives for the ALMA construction project. Since these objectives are not explicitly covered as part of the JAO Quarterly Report they are discussed here.

Where these objectives refer to quarters, they are calendar year, not fiscal year. Some milestone deliveries were affected by the rebaselining process and subsequent value balancing.

Management IPT Objectives:

- **Ensure that PMCS earned-value reporting is available by Q1 2006:** *Completed. The first Earned Value Report was distributed by JAO in March.*
- **Hold a successful Cost Review of the ALMA project in October 2005:** *The joint ALMA Cost Review was successfully completed. In the final days before the Cost Review it became clear that the project would procure antennas from two different vendors and that a Delta Review would be required in the early New Year to examine the cost implications of this. In addition, NSF requested a North American Cost/Management Review to review the NSF component of the ALMA budget and on a similar timescale to the Delta Review. The Delta Review and NA Cost/Management Reviews were both held successfully at the end of January.*
- **Finalize the agreement between AUI and NINS/NAOJ by Summer 2006 (subject to NAOJ submittal of their final RFQ):** *Final RFQ from Japan may be as late as May 2006, in which case this may become late summer.*
- **Finalize the MOU between the NRAO and HIA by November 2005:** *Completed on schedule.*
- **Support AUI in determining an acceptable method of employing local staff by Spring 2006:** *Completed in January 2006, with NSF and ESO agreeing that AUI would hire the local staff.*

Site IPT Objectives:

- **Complete construction of the AOS Technical Building by April 2007:** *The building construction completion is on track. The Foundation and Shell Packages have been completed on schedule.*
- **Complete construction and outfitting of the OSF Contractor Camp by November 2005:** *Completed in November 2005.*
- **Issue Invitation for Bids for AOS road and power design in December 2005:** *This bid will be released in April 2006. Road construction will start in Q3, 2006. The power distribution design should be finished by late 2006 and construction is scheduled for Q3, 2007.*
- **Complete procurement of AOS Technical Building outfitting material by March 2006:** *Bids were opened in March 2006. Purchasing is ongoing and on track.*

- **Complete ALMA–supplied site work at the Vertex site-erection facility by April 2006:** *On track; grading has been completed, and antenna foundations have been put out to bid and are in the evaluation and award process. Utilities installations are in bid process and scheduled to be completed in Q2 2006.*

Antenna IPT Objectives:

- **Hold the Antenna Preliminary Pre-Production Design Review in January 2006:** *Scheduled for 9 and 10 February 2006; meeting was delayed 3 weeks from the original schedule date to accommodate the North American ALMA Cost/Management Review in January.*
- **Hold the Antenna Pre-Production Design Review in June 2006:** *This objective is running late due to: i) the Finite Element model development taking longer than predicted, ii) design of the transporter interface, and iii) a delay in getting the subcontract for the azimuth bearing in place. The specifications for the azimuth bearing, especially the 'wobble' specification, are extremely difficult, and Vertex has spent significant effort working with the vendor to get this under contract. The Pre-Production Design Review (P2DR) is expected to be ~2 months late, although this is not yet formalized. However, procurement of long-lead items such as the CFRP Backup structure, Invar support cone, aluminum reflector panels, bearing, encoders, and hexapod is moving forward and vendor ship dates are planned for mid-July to mid-August 2006.*

Front End IPT Objectives:

- **Approve the final design of the pre-production front-end chassis in January 2006:** *This activity is currently scheduled to complete 26 June 2006. The delay can be attributed to unexpected difficulties in fiber optic cable thermal isolation and routing, the Chassis Thermal Design Review, and preparation of documentation for the CDR.*
- **Freeze the hardware design of the monitor and control circuit in February 2006:** *This activity is currently scheduled to complete on 12 June 2006. Although this delay appears to be ~ 4 months past due, a re-planning effort in late December 2005 shifted the target completion of this milestone out to early April 2006. The true 2-month delay is attributed to design delays for Cryostat M&C and procurement delays in the CPDS & IF modules.*
- **Make the NA Front End Integration Center operational in April 2006:** *This activity is on track for 17 May, with two provisos: (1) initial measurements will utilize harmonic mixers to lock the LO until the LORTM (optical signal generator needed for simulating the ALMA LO reference) is delivered; (2) the beam scanner vendor has delayed delivery until 28 July 2006 (vendor claims to have diverted personnel to work on an urgent national security job).*

Back End IPT Objectives:

- **Complete the CDR on all BE equipment by October 2006:** *A final BE CDR will be re-scheduled after revised system technical requirements have been approved by the Project, and perhaps after some level of testing of pre-production modules at the ATF and/or at the AOS.*
- **Deliver pre-production racks to the ATF to support production receiver by August 2006:** *Pre-production racks cannot be used at the ATF until the production receiver arrives; the production receiver is now scheduled for delivery in Oct 2007. Only the prototype antenna racks can be used with the evaluation receivers currently installed at the ATF. A set of pre-production antenna racks can be delivered to the ATF as early as February 2007; the delay is the result of anticipated late delivery of the*

pre-production IF processor modules from the vendor.

- **Deliver empty racks to the OSF for "form fit" test in antenna by Aug 2006:** *Requirements have increased to include on-axis wraps, fiber optic splice boxes, and heat-dissipating "dummy" rack modules instead of "empty" racks, but delivery is still on track.*
- **Ship the LO reference to the OSF for the AIV (assembly, integration, and verification) single-antenna test by October 2006:** *Requirements for the AIV tests have changed to include deliverables from FE and Computer IPTs, but BE deliverables for temporary Central LO can be delivered on schedule. Prototype antenna racks, also necessary for the AIV tests, will not be delivered until February 2007, however. The delay in delivery of the antenna racks is the result of anticipated late delivery of the pre-production IF processor modules from the vendor.*
- **Test photonic LO prototypes at the ATF by June 2006:** *The LO Photonics prototype modules have been delivered to PSI at the AOC for test. The date of delivery to the ATF is dependent on the PSI schedule, currently set for August 2006. The PSI delay is due, in part, to phase drift errors in the 125 MHz LO reference, the need to increase dynamic range of fiber stretcher in the Line Length Corrector, and in resolving any further problems with the Data Transmission System. The problems were discovered during PSI tests on the BE prototype antenna racks.*

Correlator IPT Objectives:

- **Prepare the first quadrant of the correlator for shipping in June 2006:** *This activity is on track, if we choose not to delay it. Once ready for shipping, the 1st Quadrant will go into storage for a period of ~1 year until it can be received at the OSF. This, in turn, will allow space for the 3rd Quadrant to be assembled and tested. It may be possible to delay for a few more months while part of the 3rd Quadrant assembly is done in the correlator lab, reducing the length of time the 1st Quadrant spends in storage.*
- **Ship test fixtures to Chile in June 2006:** *This activity can be done on target. However, unless there is a test lab either at the OSF or in Santiago, this shipment may be delayed without adverse effect—it is not really needed until the 1st Quadrant arrives in Chile.*
- **Complete assembly of the second correlator quadrant in June 2006:** *This activity is on track. The 2nd Quadrant has the station and correlator racks assembled and the power rack reconfigured. Installation of boards, DRX cards, and TFB cards will begin soon, followed by integrated testing.*

Computing IPT Objectives:

- **Make a major software release in December 2005:** *Check-in of the software for the R3 release occurred in October 2005, with the integration process completed in December.*
- **Make a minor software release in June 2006:** *This will be completed in mid-April, about 6 weeks earlier than scheduled. The integration has gone much more efficiently for this release than for those previously because of the software stability initiative and the extensive testing in support of the optical pointing tests.*
- **Support first fringes at the ATF in June 2006:** *Development and testing in progress; completion will depend on successful completion of sufficient hardware and software testing in the lab. It would not be prudent to move to the ATF prematurely, since debugging is more difficult there. Meeting this date is possible but not likely.*
- **Hold an incremental CDR in June 2006:** *Completion expected as scheduled.*

ALMA CONSTRUCTION

Systems Engineering & Integration IPT Objectives:

- **Begin detailed planning of antenna AIV (assembly, integration, and verification) in Chile in January 2006:** *Detailed planning has begun (this is a JAO Project Engineer deliverable).*
- **Install full electronic system and control software on the ATF antennas in January 2006:** *Running approximately eight months late owing to late delivery of hardware to PSI and difficulty in achieving reliable system connectivity and system stability. Cross-correlation from the analogue IF input to the Correlator has been demonstrated in the lab and complete LO sub-system tests are underway. Full system connectivity should be accomplished in May and system-level testing should begin.*
- **Obtain first fringes at the ATF by June 2006:** *Running late, owing to the delayed move of prototype hardware and software to the ATF.*
- **ICDs for baseline and Enhanced ALMA substantially complete by July 2006:** *On track. (This task is a European deliverable.)*
- **Release system performance budget document in March 2006:** *On track; a Local Oscillator performance budget and analysis was distributed in January 2006. A system analysis package is now available and is awaiting input of test data to move from being a performance budget to an actual performance predictor. (This task is a European deliverable.)*

Science IPT Objectives:

- **Deliver the final long-baseline configuration in December 2005:** *A strawman long-baseline configuration design was delivered in July 2005. This design awaits reconciliation with the design for the road and fiber network on the site. The Statement of Work and specifications for the latter have been submitted by the Site IPT.*
- **Deliver all remaining baseline configurations in September 2006:** *On schedule.*

Atacama Large Millimeter Array

Quarterly Report for the period January-March 2006

Submitted to the ALMA Board by the Joint ALMA Office
M. Tarenghi, ALMA Director

Table of Contents

1. Management IPT

1.1 European Project Office

1.1.1 Overview

1.1.2 Personnel

The vacancy for the ALMA Regional Center (ARC) Manager was announced. Applications for the position were received and candidates were interviewed. The most suitable applicant has been identified and a contract is under negotiation.

The vacancy for the Front End Production Engineer was announced and several applications were received. Several interviews were held, but no suitable candidate was found. The vacancy for this position was re-announced with a deadline for submittal of 25 April.

Procedures for hiring International Staff for ALMA in Chile are under discussion. These personnel will be hired directly by one of the Executives.

At the last ESO Council meeting, held on 7 and 8 December 2005, the hiring of ALMA Local Staff (Cou-1060 + Add.) was discussed and the Council resolved

> *"… that a Council delegation should urgently offer to go to Washington D.C. to explain the ESO position directly to senior officials in NSF and is given full authority to negotiate directly with NSF to secure a mutually acceptable mechanism for the employment of ALMA Local Staff in Chile, …."*

A meeting at NSF in Washington was held on 9 and 10 January 2006. Several conclusions were reached; among them:

> *"ESO Council would concede that we should pursue the option of AUI hiring all the local labor."*

ESO Management is in discussion with AUI to define and implement procedures related to the hiring of Local Staff.

1.1.3 Santiago Offices

At the meeting between an ESO Council delegation and Executives of NSF in January 2006, it was concluded:

> *"… ESO Council and NSF recognized the benefits of the offer of land at the Vitacura site for the location of the Santiago building."*

Consequently, first meetings on the ALMA Office building in Santiago were held. Related work packages have been transferred from JAO to the Site IPT.

1.1.4 ALMA Delta Cost Review

Following the ALMA Cost Review held in October 2005, a Delta Cost Review was held on 26 January 2006 at NSF in Washington. The main purpose of this review was to understand and review the cost implications arising from the fact that, within the bilateral ALMA project, two different antenna suppliers have been selected. The ESO Deputy Director General, the European ALMA Project Manager, the

European ALMA Science IPT Leader, and the Antenna IPT Leader participated in this review. All ESO participants provided detailed information, with further clarification in response to questions raised by the Review Panel. The Review Panel consisted of seven members, all of whom had participated in the October 2005 ALMA Cost Review. The executive summary concluded:

"*With a high degree of confidence, we conclude that the use of two antenna types poses no major risk to the successful development of ALMA or to meeting its science goals and represents an inconsequential change in the project cost (about 1% of the total estimated project cost).*"

1.1.5 Contract Activities

ESO signed the antenna procurement contract with the AEM (Alcatel Alenia Space France; Alcatel Alenia Space Italy; European Industrial Engineering S.r.l.; and MT Aerospace AG) Consortium on 6 December 2005. The contract concerns the design, manufacture, transport, and integration of 25 ALMA Antennas on site in Chile, with the option to purchase additional antennas up to a total of 32. The kick-off meeting for this contract was held at the Alcatel Headquarters on 19 and 20 December 2005. Besides the day-to-day interaction with the AEM Consortium, three monthly technical progress meetings (face-to-face) were held during the reporting period. In these meetings, the ESO team noted positively the good integration and work sharing between European Industrial Engineering, the overall designer of the antenna, and Alcatel Alenia Space Italy, in charge of various system analysis and design tasks.

Following the signing of the procurement contract for two antenna transporters with Scheuerle Fahrzeugfabrik GmbH in December 2005, the kick-off meeting and progress meetings were held. One of the meetings was held at the OSF and AOS site, to provide a better understanding of the conditions under which the transporters will operate.

A large number of companies were invited to submit bids for the Technical Facilities at the Operation Support Facility (OSF). Only a very small number of companies submitted offers. These were opened on 29 August 2005. Initial technical and commercial evaluations were made. Clarification meetings were held with those companies who had submitted technically and contractually compliant bids. Due to budgetary constraints, these offers were not affordable. Therefore, a new call for tender, with a reduced but partially recoverable scope, was issued. The replies were opened on 9 February 2006. A supplier has been identified and a proposal to negotiate and conclude a contract with this bidder will be made to the ESO Finance Committee at its next session, scheduled for 9 and 10 May 2006. It was decided to proceed with the baseline layout of the OSF, including two of the four options (the 25 cm concrete pavement around the buildings and the transporters shelter). Two other options, the movable hangar and the ALM (Administration Logistics Management) building will not be contracted. However, recovery plans with acceptable solutions have been developed. It should be noted here that the bids received were all substantially higher than the initially estimated cost. However, in view of the steep increase of cost of construction in Northern Chile during the rebaselining process, the initial cost estimates had been significantly increased. These increased cost estimates have been implemented in all documentation and budgets. Therefore, the cost of the proposed contract is covered by the approved ESO budget.

An update of the feasibility study for the design of the Power Generation and Transmission Systems has been delivered by Lahmeyer International, Germany. One result of this study indicates that ALMA cannot be certain of a gas supply for a dual-island-mode power station at the OSF, which had been the preferred mode of power supply. Alternative supplies, in particular electricity from suppliers in Northern Chile, are being analyzed. In this aspect, the frequency and duration of interruptions is a concern. ALMA intends to obtain information on stability and a price quotation for a power supply system that is predicated upon obtaining power off the existing electrical grid.

Over the last two years, ESO has signed several development, prototyping, and pre-production contracts for the ALMA Front End, Back End, and Correlator projects with experienced and qualified institutions in ESO Member States. The contractual amount of all these contracts is about 14.7 MEUR. Most of the contracts are completed or are close to completion within the contractual price and within the revised schedule. Some modest cost overruns (about 6%) have occurred due to delays and changes of scope of the work packages.

The current Band 9 Cartridge contract for design, development, and pre-production of eight units is facing delays and additional costs beyond the responsibility of the Contractor, NOVA. An amendment to the current contract between ESO and NOVA has been discussed and is in preparation for presentation for approval at the ESO Finance Committee meeting in May 2006.

The contract for the prototype design, manufacture, and testing of the Tunable Filter Cards for the Correlator has been concluded with the University of Bordeaux. The award of the follow-on production contract with the University of Bordeaux contract was approved by the Finance Committee in November 2005. All reviews necessary before starting production have been held and it is expected that the contract can be signed within the next two months.

1.1.6 Technical and Managerial Concerns

Site

- There is general concern about the cost development of construction in Northern Chile. The construction schedule and the timely completion of construction activities are carefully monitored and, where necessary, corrective actions are being taken.
- The ALMA and contractor camps are reaching their limited capacities.
- The OSF contracts need to receive approval of the Finance Committee in May.
- In the course of rebaselining the ALMA project, the value of many work packages has changed. A decision on the value balance transfer of work packages from North America to Europe is pending and needs attention as works are proceeding.

Antenna

- In general, the resources in the AIPT are rather limited compared to the real evolution of the tasks demanded by the project. The existence of two parallel contracts for the antennas is generating additional work, compared to what was originally planned.
- Operation of the AEC prototype antenna at the ATF in Socorro is also adding to the work load. Experience over past months indicates that sensible effort has to be spent on this, both to maintain the prototype antenna operationally and to support the Software group using it.
- The alignment of the foundations is dependant upon finalization of the design. This prevents the final alignment from being performed before the tooling has been tested and shipped to Chile. The possible time impact is under investigation.
- The unavailability of the originally selected tires for the transporter is causing a transporter redesign and possibly one month of delay in the delivery of the first unit.

Front End

- Further problems with the supply of components for the Band 9 Cartridges are leading to additional cost.
- It is essential that information on the FE test station replication be available soon.

Back End

- Partial redesign of the Digitizer Assembly is under consideration due to a change in requirements.

- Some faulty Digitizer Chips were found; this is under investigation.
- The procurement of additional components for the ACA (ALMA Compact Array) shall be concluded as soon as possible due to limited availability.
- The DTS link still shows some instability; the optical part has been excluded as the source of the problem. The construction of the fiber system requires a tight interaction with other IPTs; mainly Site. This should be well coordinated in order to avoid schedule and technical problems.
- There could be the need for additional LO and Photomixer devices both for the FE IPT and for the ACA; currently under consideration.
- In order to meet the schedule, a decision on the requirements on the Master Frequency Standard shall be made soon.

Correlator

- Thermal dissipation of the Tunable Filter Bank could be an issue; however the design has been thoroughly tested and conditionally passed the CDR (with some pending actions).

Manpower

- Hiring Local Staff and International Staff Members to work for the AIV in Chile is getting increasingly important and urgent.

1.2 North American Project Office

1.2.1 Overview

- The period in review has once more been dominated by the rebaselining exercise and the subsequent reviews. Two more Reviews were held in January 2006: First, the Delta Cost Review, followed by the North American ALMA Cost/Management Review.
- The Delta Review comprised a subset of the original Garmisch Review panel and concluded that the project had made good progress and had correctly assimilated the costs of having two antenna vendors.
- The North American ALMA Cost/Management Review was chaired by Don Hartill from Cornell and was an independent review of both the North American costs and the North American Management of the Project. This review was a success and concluded that the costs were both understood and under control; they further concluded that the NA ALMA Management was capable of delivering its part of the project.
- The Value Balancing Exercise was concluded in this period and determined that a transfer of work to the value of $13.7M (Y2K) from North America to ESO was required. This was accepted by the Executives and the ALMA Board in their February Telecon. At the Kyoto face-to-face meeting, the ALMA Board endorsed the proposed implementation plan to actually transfer the work.
- The issue of who hires the local labor in Chile has been successfully resolved with an agreement between NSF and ESO that AUI will be the employer.
- A Preliminary Pre-Production Design Review (P3DR) for the Vertex Antennas was successfully held during the week of 6 February 2006 in Duisburg, Germany.
- Significant progress has also been made across the project as a whole to continue and strengthen the process of the delegation of authority to the JAO.

1.2.2 Personnel

- Peter Napier joined ALMA in late January 2006 as Team Leader for the Prototype System Integration group in Socorro. Peter had been involved in the early days of ALMA. Until rejoining ALMA, he had been the project manager for the EVLA in Socorro.
- Tony Rodriguez joined the Antenna IPT in March as the Quality Assurance Engineer.

1.2.3 Contract Activities

- During the period January through March 2006, significant ordering and new contract activities were minimal.
- A contract for grading the contractor's antenna erection area at the Operations Support Facility (OSF) in the amount of US $184,067 was awarded to Con-Pax.
- An agreement for IT services for the JAO and the OSF from March to December was awarded at an approximate value of US $98,007.

1.2.4 Technical & Managerial Concerns

- The biggest Managerial concern for North America remains the securing of necessary resources to complete the project. To this end, the recent NA Cost Management Review has been a pivotal milestone.
- In terms of technical concerns, the Photonic LO (a high risk item) has reduced further in risk with a successful test of the fiber cable wrap. Band 9 LO power remains a concern, but the team is confident that the problems can be overcome. Tests of the redesigned system are imminent.

2 Site IPT

2.1 Status

2.1.1 Antenna Stations (foundations) at the AOS (NRAO)

Standard basic design, included in the re-baselining estimate, is the EIE design. An alternative design could be implemented at areas of lower rock elevations, where the current EIE design may not be used. Other modifications include the new transporter requirement to drive onto the foundations during antenna loading and unloading operations.

The documentation for tendering the antenna stations at the high side are under preparation. Further activities are pending the outcome of the value balancing between NA and EU.

2.1.2 Technical Building at the AOS (NRAO)

Construction of the AOS Technical Building Foundation and Shell Packages started on 20 September 2005 and shall complete by mid April 2006. An extension period of three weeks has been granted. At the end of this reporting period, the work is 95% complete.

At present, the foundations are 100% complete and the steel structure is 100% installed. The concrete and steel panels for the building's walls and roofing are being installed; work is scheduled to be finished in the next 3 weeks.

AOS Technical Building.

The Completion Package Contract has been awarded and the NSF approval is under way. Work should start in April 2006. Completion is scheduled to be in April 2007.

2.1.3 Permanent Access Road (ESO)

In March 2006, the 43 kilometers of modified road formation level of the access road from the Chilean highway CH23 via the OSF to the AOS have been completed. The road pavements will be contracted at a later date (2007-2008). Complementary Work including the completion of the formation level, slopes, and drainage trenches will be completed during 2006.

Road completed to final width.

2.1.4 Technical Facilities at the OSF (ESO)

After analyzing the incoming bids of the OSF tender in September 2005, a revised tender documentation for the construction of the Technical Facilities at the OSF was released to the last two (2) bidders for re-bidding on 9 December 2005. The tender closing date was 2 February 2006. The two (2) incoming bids have been analyzed and the contract proposal was presented to the extraordinary Finance Committee meeting in March 2006. The documentation is currently being revised for a presentation to the Finance Committee in May 2006. Thus, the Contracting could start in July 2006 and Provisional Acceptance is scheduled to be in December 2007

2.1.5 ALMA Project Power Supply (ESO)

The contract for the design of the Power Generation and Transmission Systems and elaboration of the update of the feasibility study of Fichtner has been awarded to Lahmeyer International, Germany. The update of the original feasibility study was advisable due to the changed situation in Chile with respect to the natural gas supply and the recent fuel price increases. The Power Generation Study was received and analyzed.

Earthworks completed at OSF.

At the ALMA Board meeting in Japan in March 2006, the decision was taken to connect the ALMA power supply to the local grid. The Statement of Work of Lahmeyer to reflect the changed scope of Work is currently being prepared.

2.1.6 ALMA OSF to AOS Fiber Optic Link (ESO)

During this reporting period the matter was not further followed, as the finalization of the power generation is still under progress.

2.1.7 Environmental Aspects

Since the road construction works were completed in March 2006, a new survey of the vizcacha colonies is scheduled in April and May.

2.1.8 Configuration Review

The layout of the antenna foundation locations at the AOS area is being changed. Apparent discrepancies between the aereophotograpic survey and actual UTM locations will require check and confirmation of locations.

2.1.9 Antenna Contractor Lay Down Areas (NRAO)

The lay down areas for the North American and Japanese antenna contractors have been graded. The antenna foundations have been bid, the Contract was awarded, and the NSF approval has been requested. Construction of the antenna foundations and utilities installation will start in April 2006. Work to be finished by July 2006.

Vertex SEF graded.

The European AEM antenna lay-down area is scheduled to be completed during the first quarter of 2007.

2.1.10 Culverts and Drainage Structures (ESO)

Work on the construction of culverts and drainage structures at canyon crossings of the road to the OSF and the AOS started at the Km 6.9 culvert. Documentation for all remaining culverts has been approved by the extraordinary Finance Committee meeting in March 2006. Completion of all remaining culverts is scheduled in mid 2007.

2.2 Concerns and High Level Risks:

- Late start of Antenna Foundations at the AOS site due to pending decision on value balancing between EU and NA.
- Fiber Optics design by Back End and Computer Group.
- Late start of the Permanent Power Supply.
- Changed antenna station layout.

Construction of culvert.

Concrete works complete.

2.3 Next Period Goals:

- Complete construction work for the interior finishes and elctromechanic installations of the AOS Technical Building.
- Design and preparation of the tender and construction documentation for the power generation and transmission system (Permanent Power Supply).
- Start construction of the OSF Technical Facilities.
- Complete Tender action for the construction of the road intersection with Chilean road CH23.
- Finish bidding for AOS road and utilities design; start this design work.
- Start building the antenna foundations within the Antenna Contractor's areas.

3 Antenna IPT

3.1 Status

3.1.1 Production Antenna Procurements

3.1.1.1 NA Antennas

- A Preliminary Pre-Production Design Review (P^3DR) was held the week of 6 February in Duisburg, Germany. Status of FE modeling, production antenna redesign details, and metrology system design were the primary areas of focus. Representatives from JAO, ESO, NAOJ, and NRAO attended P^3DR.
- 72 action items (AIs) closed during the quarter; remaining open AIs: 16 for Vertex and 13 for NRAO.
- Major technical issues resolved: transporter flange interface, azimuth bearing loadcase definition, antenna lockout & interlock design details, CloudSAT automatic shutter closure avoidance,
- Completed design of antenna pre-assembly integration facility for Vertex Kilgore, TX, location and broke ground on construction.
- Site visit, inspection, and finalized design details for Vertex Site Erection Facility (SEF) at OSF in Chile. Preliminary contact and evaluation of Chilean construction companies while in Santiago.
- Long lead item contracts in place with firm price and delivery dates for all CFRP components, machined aluminum reflector panels, Azimuth and Elevation encoders, bearings and gearboxes, Hexapod positioner, Invar cone, and gear segments.
- Manufacturing drawings released for Support cone, receiver cabin, elevation gear rim and azimuth cable wrap support.
- Full FE model combining azimuth and elevation sections has been completed, and individual structural analyses are in-progress.
- On-site Antenna IPT engineering support to Vertex one week every three weeks.

3.1.1.2 European Antennas

- First Progress Meeting held on 1 February 2006 at European Industrial Engineering premises in Mestre, Italy. During the meeting, the first schedule was discussed together with the full logic of the design Phase until PPDR. In addition, the meeting was centered on the engineering topics. Of particular importance were the topics on which ESO had asked modifications from the design of the AEC prototype, basis for the AEM design, given the experience accumulated in testing and operating the prototype.
- AEM has submitted the first batch of documents demanded by the Statement of Work. Comments were passed and the documents are under updating by AEM.
- A second progress meeting was held on 1 March 2006 at Alcatel Alenia Space in Toulouse, France. The major subjects of the meeting were the Product Data Management system selected for the meeting and the technical advancement of the design.
- The Finite Element Model had been updated and first analyses completed, including the Computational Fluid dynamical wind analysis and a first version of the error budget (passive, without active metrology).
- The first phase of the design activities, namely the conceptual design phase, was completed at the end of March 2006. This phase is used to define the major architecture of the antenna in order to allow the detail design to proceed. A first set of high level drawings was delivered.

- The design of the on-site Work Area was discussed in a dedicated meeting and a final proposal was made and agreed with AEM. A visit to the OSF and AOS site with AEM had been scheduled for April 2006.
- A reservation on the raw material supply for the pitch fiber was done by AEM with Sumitomo/Mitsubishi, in order to secure the planning for this long lead item.

3.1.2 Vertex Prototype Antenna (NRAO)

- The Vertex antenna is operating nominally at the ATF site and being used extensively by Prototype Systems Integration.

3.1.3 AEC Prototype Antenna (ESO)

- An intervention on site by AEC was performed in February to perform minor maintenance. Successively, the AIPT intervened on site together with the Computing AIPT for ALMA control software testing.
- The antenna is operating nominally at the ATF and being used by Prototype Systems Integration.

3.1.4 Transporters (ESO)

- The Kick-off meeting was held 12 January 2006 at Scheuerle premises. The meeting was focused on procedural and communication issues. Programmatic issues and schedule were discussed.
- In February, the Scheuerle Project Manager visited the OSF and AOS site to survey the roads on which the transporter will have to operate. During this visit, important data were collected for the design and the logistic aspects of the transporter associated with their shipping to San Pedro de Atacama. The Project Manager also traveled to the ATF in Socorro, New Mexico, for familiarization with the antenna on the basis of the two prototypes.
- At the first progress meeting, held on 9 March 2006, the Contractor informed ESO of the unavailability of the tire size selected in their proposal before second half of 2007. For this reason, an alternative conceptual design was proposed, based on smaller tires, but requiring a change to the specification and ICD.
- The impact of this design change is being examined. A possible impact on the operation in the compact array and the ACA has been identified. The issue is being followed.
- A technical meeting was held at Scheuerle to discuss the propulsion system and the associated impact on the design (brakes, etc.)

3.1.5 Nutator and Optical Pointing Telescope (NRAO)

- The Nutator Technical Specification was distributed and approved via ALMA CCB process. The Nutator Statement of Work was distributed internally for review and comment. Both are ready for release to industry for formal bid response.
- Development of the Technical Specification (TS) for the Optical Pointing Telescope (OPT) started in February and was released for review within ALMA in March. Feedback is being reviewed and TS updated appropriately. Release to industry for formal bid responses is planned for May.

3.1.6 Antenna Stations Foundation (ESO)

- Work was performed on the design of the tools to be used for the alignment of the foundation interface to the antennas. An ALMA internal review was performed on 29 March, finding the proposed tools adequate for the purpose.
- The procurement of the tools immediately started with the preparation of the manufacturing drawings. It is intended to test the tools in Europe by aligning a test foundation at the transporter contractor premises. The ridges for this operation have already been procured.

3.2 Technical and Managerial Risks and Concerns

- The de-phasing between the two Executives in passing their Contract and the fact that two companies are delivering the serial antenna is an added complication in the follow up of the Design Phase by the AIPT and in maintaining the two identical sets of Specification. In addition, changes have to be propagated to parallel contracts, including the NAOJ contract with Mitsubishi. This represents an additional complication and increased manpower efforts.

3.3 Tasks during Next Quarter

3.3.1 Production Antenna Procurements

NA Antennas

- Finalize and place contracts for all remaining long lead items (UPS, motors, drive amplifiers, panel adjusters, and cladding/insulation).
- Complete and release remaining manufacturing drawings for Yoke structure of Vertex antenna.
- Complete first five FE analysis tasks.
- Place subcontracts for SEF building and construction.
- Receive delivery of construction materials and begin erection of Kilgore Antenna Pre-assembly Integration Facility.
- Continue one week every three weeks on-site Antenna IPT engineering support at Vertex facilities.

European Antennas

- Continue the design activities of the serial antenna.
- Perform a test campaign at the ATF on the AEC prototype to study options and solutions for the metrology system.
- Complete the definition of any item requiring possible qualification tests.
- Continue the system analysis (RAMS analyses, high altitude, …).
- Advance the FE analysis and the error budget.
- Continue with the update of the management documents.
- Continue the preparation of the sub-system specification.

3.3.2 Transporters

- Solve the issue of the change required by the new transporter concept proposed by Scheuerle and caused by the unavailability of the originally selected tires.
- Advance the design to a PDR level.

3.3.3 Others

- Release of Nutator Specification and Statement of Work to industry for formal technical and cost proposals.
- Complete development of specification and statement of work for the OPT device.
- Continue the support of the PSI activities at the ATF site, as needed.
- Continue the procurement of the tools for the foundation interface and procure an initial set of interface parts to serve the Contractor's work areas at the OSF.

3.4 Progress on Milestones for Last Period

1.25.05.003	Preliminary Pre Production Design Review (PPPDR) Completed 10 February 2006
1.25.05.009.15	Vertex Antenna Contractor granted access to site Completed 28 February 2006
1.25.05.009.45	Preparation of site grading for Vertex SEF assembly area Completed 3 February 2006
1.40.05.12	Prepare Nutator Design / Fabrication Specification Completed 31 March 2006
1.03.1.25.10.10	Management/Engineering/Documentation Completed 25 January 2006
1.03.1.25.10.16.005	Detailed Concept design definition Completed 31 March 2006
1.03.1.48.050.010.014	Ridge 2 and 3 Manufacturing Completed 10 March 2006
1.03.1.50.20.05	Transporter Contract KO meeting. Completed 12 January 2006

4 Front End IPT

4.1 FE IPT Management (ESO and NRAO)

Preparations have started for the production contract of the ALMA cryostats. A new Statement of Work and an updated Technical Specification have been prepared and are undergoing internal review.

The Statement of Work for the Band 3 cartridge was revised to include additional testing which has been agreed to with HIA.

Following the request received from NOVA in October 2005 for additional funding to complete the current Band 9 Cartridge contract for design and pre-production of 8 units, the contents for an amendment have been agreed to between NOVA and ESO. This amendment will be presented at the next regular ESO Finance Committee meeting for their approval.

4.1.1 General (ESO and NRAO)

On 14-15 February 2006, the Preliminary Acceptance In-house (PAI) of the Band 7 Cartridge #1 was held at IRAM in Grenoble, France. The PAI went very well; almost all requirements were met and only four NCRs/RfWs were submitted. At the PAI, a clear punch list was defined which needs to be completed before Provisional Acceptance on Site. PAS is scheduled for late April or early May 2006 and will take place at the NA FE Integration Center in Charlottesville, Virginia.

A workshop to review the Front End Support Structure (FESS) and optical/mechanical tolerances budget was held on 17-18 January 2006 at the NRAO in Charlottesville. Organization of this workshop was done by members of the EU FE IPT. The workshop was very successful; it led to a common understanding of the optical/mechanical tolerance budget and to a simpler, much cheaper (FESS) design. Savings on the production of the FESS will be between K$500 and M$ 1.

Procurement of the FESS is scheduled to begin in the 2nd Quarter of 2006. Delivery time of the first unit is 6-8 weeks. Estimated delivery of the production units (56 parts) is 14-16 months.

4.1.2 Cryostat (RAL)

Cryostat #2 was shipped to the NA FE Integration Center. PAS of #2 was completed on 16 February 2006 at the NA FEIC. Assembly of cryostat #5 has been completed and acceptance testing has begun (see Figure 4-1).

Plate drawings for the Band 4 and Band 8 cartridges were received from NAOJ and are currently under review. RAL has been asked for a quotation to produce a pre-production run of these cartridge bodies.

Figure 4-1. Cryostat production line at RAL.

4.1.3 Optics / Widgets (IRAM)

A new batch of Band 3 windows has been molded.

A first set of pre-production Band 3 warm mirrors has been manufactured. After completion of the acceptance testing, it will be shipped to the NA FEIC.

For the amplitude calibration device, current focus is to develop a cost effective method to produce the hot loads. Using aluminum casting seems to be an interesting solution, but the RF performance has to be evaluated. For this purpose, prototype Al castings are currently being produced (see Figure 4-2).

Two meetings to define the detailed design and prototyping phase for the Amplitude Calibration device were held at IRAM in March 2006.

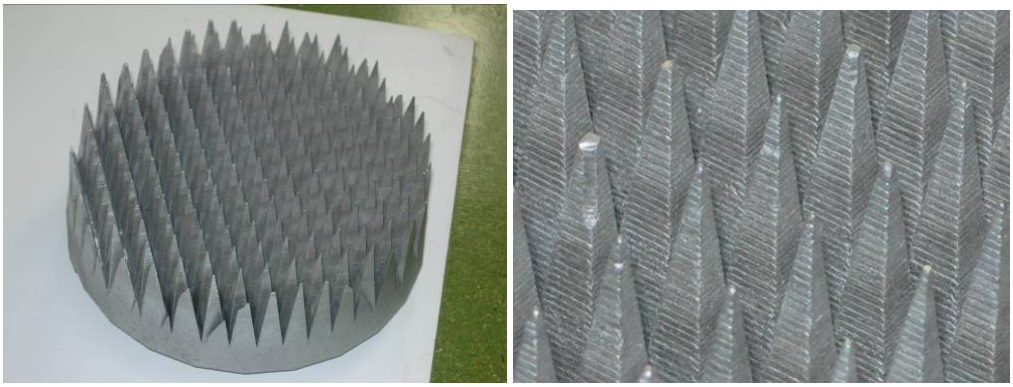

Figure 4-2. Al castings for calibration load.

4.1.4 Band 3 Cartridge (HIA)

The documentation and procedures are nearly ready to support PAI and PAS for cold cartridges.

So far, only one production SIS mixer wafer has been found to match the noise performance of the prototype wafer, and chips from this good wafer are being used to build mixers. Wafer #6 was delivered and tested, but found not to be acceptable. Good mixers are available for at least the first two cartridges.

The capability of using the cold amplifier test set to test up to 4 amplifiers in one cool-down was completed.

Cartridge #2 has nearly completed acceptance testing. There will be some performance data not measured on this first deliverable, in particular; the beam pattern measurement system has not yet been delivered to HIA. With completion of testing of mixers for cartridge #1, its assembly is in progress. Some assembly work has been done on cartridge #3.

Delivery of the first cartridge to the FEIC will be done when the documentation is all in place for PAI and PAS, and an acceptance review has been completed.

4.1.5 Band 6 Cartridge (NRAO)

Twelve test plan documents were completed during the quarter. The documentation and procedures are nearly ready to support PAI and PAS for cold cartridges.

The fraction of the total mixer chips diced, lapped, and sorted increased from 31.2% to 36.0% during the quarter. The fraction of mixer chips DC tested and ready for installation in mixers increased from 5.9% to 8.4% during the quarter.

A number of mixers suffered infant mortality during this quarter from suspected ESD damage, epoxy failures that caused mixer chips to lift, and loose bond wires. To prevent recurrences, construction and ESD procedures are being modified, humidifiers were added to the mixer assembly and test labs, and daily bond wire pull tests are now mandatory.

ACC has delivered 15 out of 24 preamps in their latest order. The pace of their construction has improved significantly, but it is still slower than anticipated. We have suggested a number of improvements to the design to simplify construction and improve performance.

The wafer yield of the best-performing InP devices has become a point of concern, and an analysis is underway to determine the minimum device-level performance that is required.

The Mixer Test System was used to test an average of 1.5 mixers per week during the quarter. The automatic liquid nitrogen fill system now permits overnight unattended operation, increasing net throughput.

Moving the Cartridge Test System from the Front End Integration Center to the Mixer Test Lab was completed during the quarter. We successfully integrated the updated design of the warm cartridge assembly that uses a new Digital Phase Lock Loop by modifying firmware and software in the test system. A design for phase stability measurements was completed and parts were ordered.

Updates were completed to the cartridge test software to interface to the latest revision of the Bias Electronics Module, which includes a digital phase-lock loop.

Cartridges #1, #2, and #3 were completed, but some rework has been required to replace lossy overmoded LO waveguide, and at present only cartridge #1 is in final form. Acceptance testing of cartridge #1 began.

Cold cartridge bodies 5, 6, and 7 were received during the quarter but body 6 was apparently damaged prior to shipment and is being returned for rework.

To remedy the long-standing shortage of LO power at the lower end of the band, additional changes were made to the redesigned overmoded LO waveguide routed between the tripler and mixer. In addition, the LO group provided a higher-power WCA using GaAs power amplifiers.

Preparation began during the quarter for shake and shock testing of the cartridges, and a shipping container is being developed to minimize shock during shipment. Various packing materials have been tested and shock from the specified 4-foot drop has been reduced from 85 g to 35 g, but more work is planned.

4.1.6 Band 7 Cartridge (IRAM)

On 14-15 February 2006, the PAI of Band 7 Cartridge #1 was held (see Figure 4-3). Representatives from ESO, IRAM and NRAO participated in this review; three observers were present from NAOJ. The ALMA Project Engineer was represented at this PAI by Ch. Haupt and E. Pangole. The PAI went very well, almost all requirements were met and only four NCRs/RfWs were submitted. Out of the four RfWs, three can be considered as minor and can be handled by the FE IPT – while one for not meeting the 2SB image rejection requirement is a more major one that needs to be decided on by the CCB. This major RfW is similar to the general CRE on relaxation on 2SB image rejection that has been recently submitted by the FE IPT. At the PAI, a clear punch list was defined which needs to be completed before PAS. PAS is scheduled in the second half of March or early April 2006 depending on availability of involved staff.

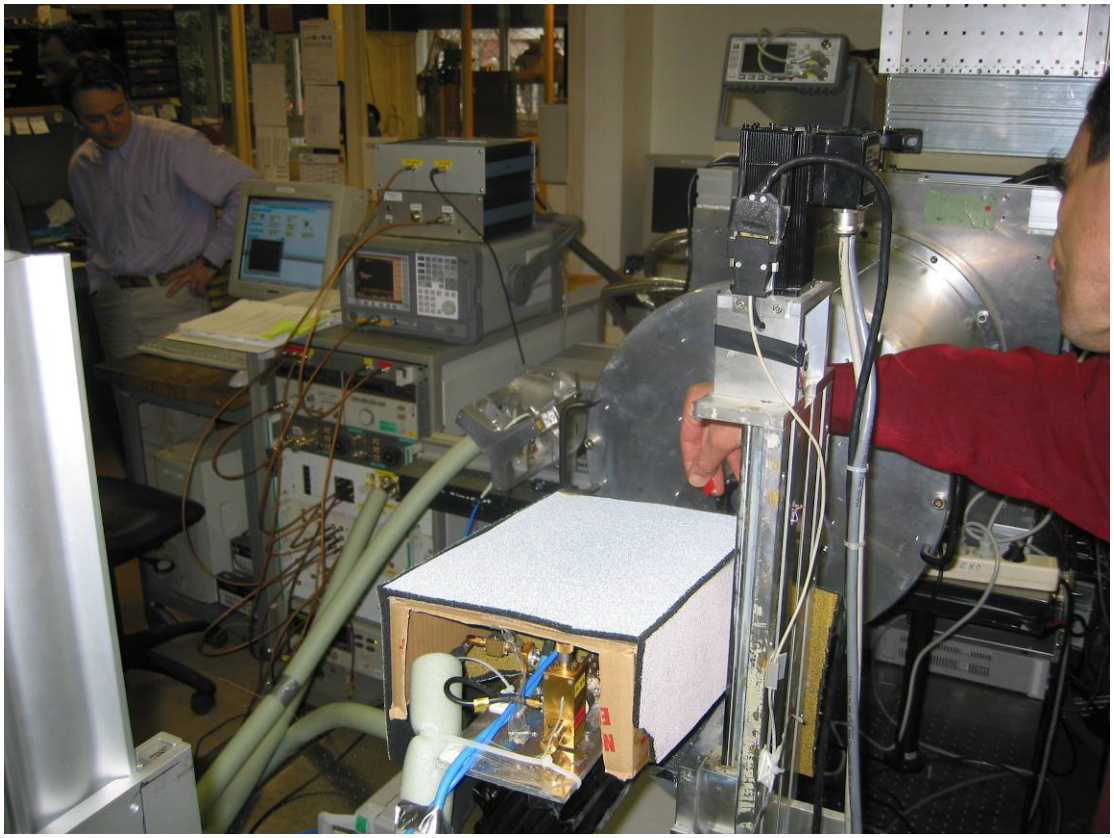

Figure 4-3. The Band 7 Cartridge phase stability test set up is thoroughly reviewed by the PAI participants.

Manufacture of pre-production cartridges advances well at IRAM; currently, #5 is underway.

All necessary cryogenic IF amplifiers (32 units) needed for the Band 7 cartridge pre-production batch have been delivered to IRAM. These amplifiers were manufactured, partially in house and by a Spanish company, under the responsibility of Yebes Observatory.

4.1.7 Band 9 Cartridge (SRON)

The Band 9 Cartridge team spent extra time on characterising the performance of the 1st LO. It was found that the available local oscillator, using a X2X3 multiplication scheme, introduced extra noise in the cartridge and suffered from power instabilities. For plans to remedy this situation, see the section below.

The first pre-production cartridge has been completed and has been subject to a full set of verification tests. At the same time, the various documents describing the acceptance tests have been written.

Preparations for a contract amendment have been made. In consultation with ESO management, it was decided to present this contract amendment to ESO FC at their May 2006 meeting instead of the extra-ordinary meeting on 2-3 March.

4.1.8 FE LO Warm Cartridge Assemblies and Frequency Multipliers (NRAO)

During this period, the following WCAs were completed and delivered:

Band 7 #3
Band 6 #1 was retrofit with GaAs power amplifiers

The following were completed but not yet delivered:

Band 6 #5 (will be used in shake test)
Band 3 #3
Band 3 #4
Band 7 #1 was retrofit with Digital Phase Lock Loop
Band 7 #4

The GaAs wafer run from NGST was finally delivered at the end of February. Early tests have revealed some lack of uniformity in performance across wafers, but it is sufficient for the needs of Band 6. The power amplifiers tested for Band 9 have so far had disappointing gain and power output. Tests are ongoing to determine the cause of these problems.

Fortunately, we have had excellent results with a new p-HEMT chip fabricated at BAE Systems on an R&D wafer at no expense to us beyond the chip design effort. This chip is suitable for both Bands 4 and 9 (using a x3x3 multiplication scheme for Band 9). The foundry has made enough chips to supply our needs for the coming year, with more available for the cost of the labor to dice and deliver them.

Eight Band 7 frequency multipliers were given acceptance testing and shipped to IRAM.

Two serious alternatives are now under consideration for the problem of Band 9 LO power which appears insoluble using the original x2x3 plan. At present, using a x3x3 chain is more promising than a x2x5 chain. We have demonstrated both power amplifier and frequency multipliers for x3x3 to have satisfactory performance. Tests of a complete x3x3 system are planned for April with a Band 9 mixer.

4.1.9 Band 3 and Band 6 Ortho-Mode Transducers (NRAO)

A system was developed and tested to cold-test the Band 3 OMTs for the first time.

Eight Band 3 OMTs were built. Four of these have been definitively tested, both at room temperature and in liquid nitrogen.

Six Band 6 OMTs were built during the quarter. Preliminary tests on two of them indicate that they are acceptable. More thorough testing, both at room temperature and in LN2, should be completed next quarter.

4.1.10 Front End Assembly Design and Construction (NRAO)

Work on the detailed mechanical and electrical design of the front end continued.

The mechanical design of the electronics chassis progressed well. The design was completed for the internal racks, side panels, and the layout of 90% of the wiring and cabling including power, IF, and fiber optics. Work continued on the simulation and analysis of mechanical deformations of the chassis. The

thermal analysis of the chassis is scheduled to be performed by an external consultant in the 2Q 2006 and will require 4-6 weeks to complete.

The design of the monitor and control electronics was completed and fabrication begun. The subrack components for the FEMC, IF switch, cryostat, and cartridge power distribution systems were purchased and received in pre-production quantities. The subrack backplanes for the main FEMC and cartridge power distribution were received and tested. The backplane designs for the IF switch and cryostat subracks were completed and the boards will be delivered in early May.

Testing and debugging of the cartridge power distribution system began. Work began on a revised version of the voltage regulator module.

Figure 4-4 shows the FEMC (top assembly) and cartridge power distribution prototype subracks ready for bench tests.

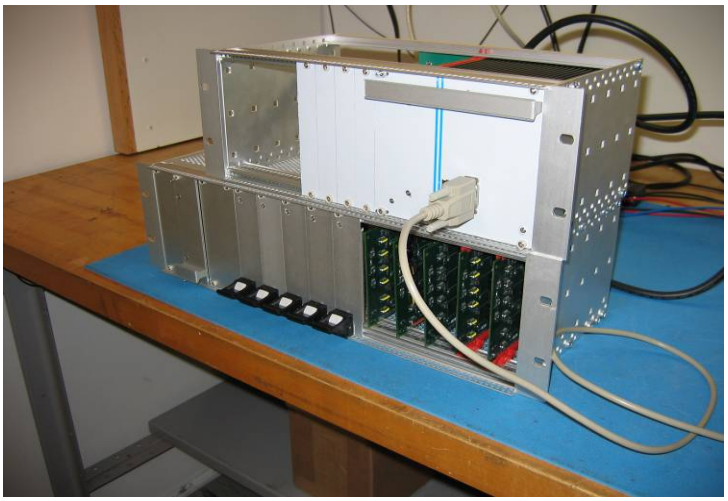

Figure 4-4. FEMC and Cartridge Power Distribution Subracks.

Ten Cartridge DC Bias Modules revision C were completed and tested. Mechanical problems with the bias module enclosure and blind-mate interface to the cartridge 300K plate require a new design of this module (rev-D) which will be available in 2Q 2006.

After a delay waiting for antenna cabin specifications to become better defined, work resumed on the FE Power Supply Assembly specifications and requirements. Procurement of the power supplies will start in May 2006.

4.1.11 Front End Integration Center Design and Construction (NRAO)

The setup of the FEIC facilities at the NRAO Technology Center in Charlottesville continued. The first of two FE tilt tables was received and installed (Figure 4-5). The FESS is normally bolted to the mechanism and is lowered to cryostat and bolted to it. The tilt table is used to rotate the FE for more convenient access to the electronics chassis sub-assemblies. One tilt table will normally be used for assembly and preliminary testing, while the other will be used for full acceptance testing.

The tilt table will allow the receiver's radio beams to be measured at any elevation angle while the components inside the cryostat operate at cryogenic temperatures. A near-field measurement system consisting of x-y-z translation stages fitted with a cold load, chopper wheel and CW signal sources will be mounted on top of the table above the receiver's vacuum windows.

A cartridge loader was developed to facilitate the installation of cartridges into the cryostat. The loader and a second tilt table will be delivered and installed in April 2006. An environmental chamber will be built around one tilt table to simulate the antenna's cabin temperature, humidity, and air flow by the end of April.

The assembly and testing of the IF Processor System was completed. The system is the main custom component of the Front End Test and Measurement System (FETMS), which consists of the 4-channel IF processor chassis, spectrum analyzer, dynamic signal analyzer, IF power meters, IF detectors, and control computer.

Work continued on other components of the FETMS. The cold load system and the chopper wheel hardware were assembled and tested. The cold load will be calibrated using Bands 3, 6, 7, and 9 cartridges in the 2Q 2006. The phase noise test system was received and is ready to be used. The manufacturer of the near-field beam scanner encountered a delivery delay, but the start of integrated testing will use workarounds.

The design of the phase drift test set was completed. The design uses FE first LO signal sources modified to cover the entire front end RF frequency bands. This signal source is phase locked to a reference signal provided by the Local Oscillator Reference Test Module (LORTM). The LORTM will provide both a photonic signal for the FE local oscillator and for the signal sources used to make phase drift, beam pattern, and gain compression measurements.

The LORTM is different in function and design from the ALMA LO photonic reference system (although it provides a certain subset of that system) and is the most challenging component of the test set. Procurement of the LORTM is scheduled to start in April and the estimated delivery date is January 2007. Until then, the LO reference signals will generally be provided by electronic rather than photonic means. For testing with the photonic LO (i.e., photomixers), reference optical signals will be generated by the BE group in the adjacent building and transferred over fiber optic cable to the FEIC.

Figure 4-5. NRAO FEIC Tilt Table with cryostat attached.

4.1.12 Front End Integration Center Design and Construction (RAL)

A management and technical team has been formed at RAL to design, build, and operate the European FEIC. Regular videoconferences for interchange of information between the NRAO and European groups are held two times per month.

4.1.13 Water Vapour Radiometer (MRAO)

The two prototype WVRs and the necessary relay optics have been installed on two SMA antennas on Mauna Kea. They have been working well and the measurements show that they are meeting (in fact, exceeding) the requirements in terms of sensitivity, stability, and so forth. The radiometers have so far proved very reliable and the interfaces to the SMA control system are robust and effective. The WVRs are operated from the UK and the water content of the atmosphere can be read out in real time, showing the fluctuations.

The WVR team has made simultaneous measurements of the water emission and of the interferometric phase using quasars (in this case 3C273) with a baseline of ~200m. A basic analysis of this data has been carried out (see Figure 4-6). This involves deriving from the radiometer readings the amounts of water along the line of sight of each antenna, taking the difference in these amounts, and then predicting what phase variation at 183 GHz would be caused by this difference.

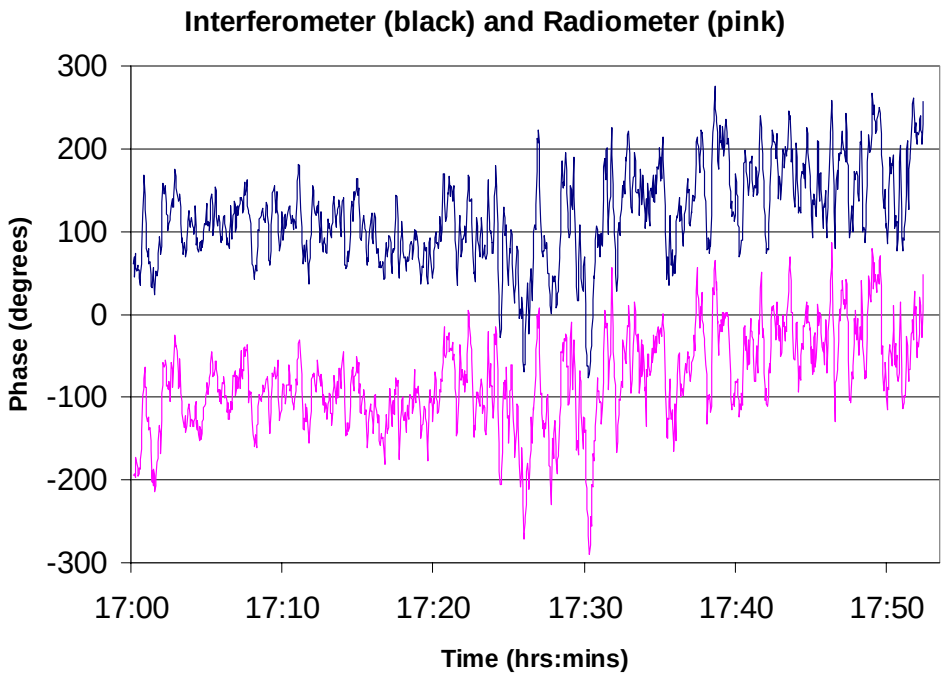

Figure 4-6. Measured interferometer phase and phase predicted from WVR data.

It is clear that the agreement is extremely good; in fact, the correlation coefficient is over 0.9. These observations were made at night and under relatively poor conditions (3 to 4 mm of water in the line of sight) but they are clearly very encouraging.

4.1.14 ALMA-J (ESO, NRAO, NAOJ)

A delegation from the NAOJ working on ALMA-J receivers participated in the Band 7 cartridge PAI at IRAM on 14 and 15 February 2006. Following this meeting, a visit to ESO was made. During this stay at ESO, the ALMA-J RfQ and schedule of ALMA-B and J FE IPT activities were addressed. The Band 4 and Band 8 groups are providing regular progress reports to the ALMA-B IPT.

A bench model first LO assembly suitable for parts of the Band 4 and Band 8 mixer bands was delivered to the NAOJ for early testing. Comparison with results obtained using a Gunn oscillator (Figure 4-7) are very encouraging.

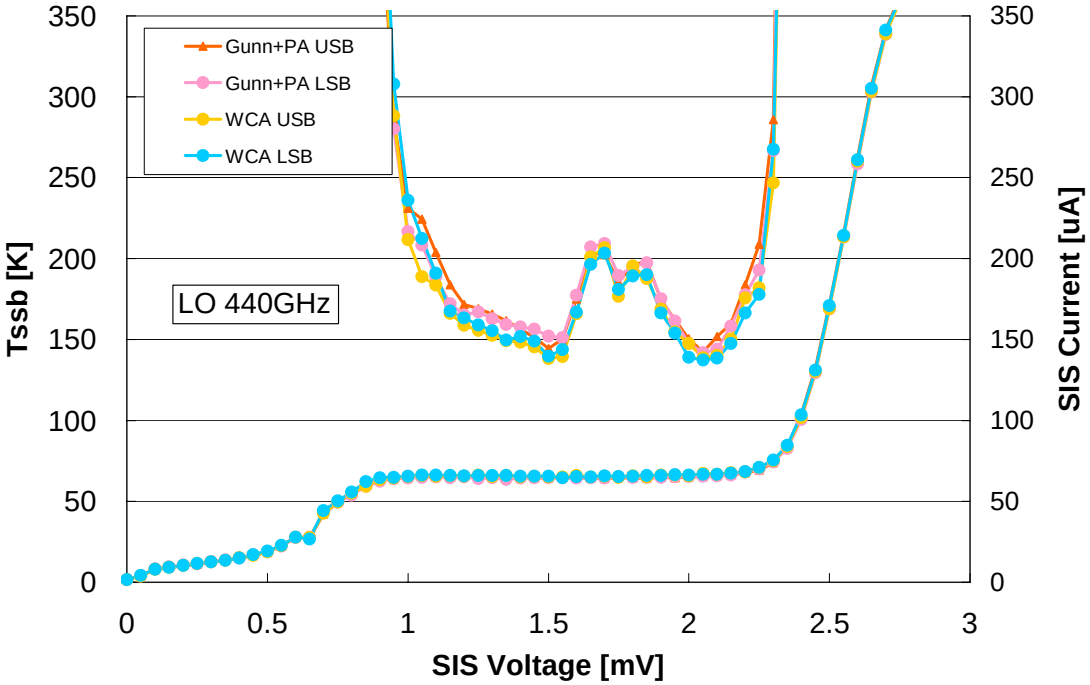

Figure 4-7. Comparison of Band 8 noise temperatures: pre-prototype ALMA WCA vs. Gunn.

5 Back End IPT

5.1 Planned versus Actual Accomplishments over the Period

- Completed procurement for pre-production antenna modules. NA
- Began preparation of Acceptance Plans for pre-production modules. NA
- Verification tests of prototypes are in progress at the test stand in Socorro. NA
- Completed tests of antenna fiber cable wrap prototype. NA
- Production and testing of LO photomixer blocks have progressed, ~25% (10) devices manufactured and successfully tested. Euro
- Teraxion has proposed a combination Laser Synthesizer / Slave Laser module to replace existing temporary design. The impact of the proposal on the microwave reference is under study. Procurements of Master Laser, new Laser Synthesizer, and Central Variable Reference microwave reference are delayed to next reporting period because of delay in receiving Teraxion proposal. NA
- A re-build of both hardware and firmware for the Fine Tune Synthesizer used in the 1st and 2nd LO synthesizers has corrected synchronization and "return-to-phase" problems encountered during frequency changes. An ambiguity in the Timing Event (48 ms) and 125 MHz LO Reference during startup has been identified and a firmware fix scheduled. The change will require CREs to the ICDs between BE and Computer IPT. NA
- Continued negotiating completion of external ICDs. NA and Euro
- Completed design of fiber optic cable choice and fiber optic cable management plan for AOS TB and conducted final design review. Some action items remain to address ACA and LO requirements. Euro
- Pre-production of Optical De-Mux/EDFA delayed because of unavailability of AMBSI2 modules. Euro
- Pre-production Digitizers and Digitizer clock assemblies not delivered to NRAO; waiting for progress on DTS integration tests Euro
- Performed the fiber splicing trials at the AOS. Euro and NA
- Started the design for the electronic racks anchoring system design for the AOS Technical Building NA
- Master Frequency Standard procurement on hold waiting for approval of reduced requirements (planned for the SRR review) Euro
- Several DTS de-formatters (new design) were shipped to Charlottesville for testing in one rack of the 1st correlator quadrant. The tests uncovered a timing problem with the new Correlator Filters. The Correlator IPT has requested further shipment be delayed until the filter timing problem is identified and corrected. NA
- No request for quote yet received from NAOJ for delivery of BE modules to ACA. A consensus on best configuration for array-wide subarraying (AWS) was forwarded to JAO; negotiations continue. AWS provides for ACA and bilateral array-wide subarrays. NA and Euro
- Detailed electronic circuit board production drawings were forwarded to ASIAA for its use in developing alternate quotes in Taiwan. NA

- Control problems with BE power supplies have been identified and corrected. The Monitor and Control interface firmware was modified to incorporate an orderly rack over temperature shut down. NA
- The new DTS formatter (digital transmitter) and de-formatter (digital receiver) boards were successfully tested using the "1/2 transponder" COTS optical components. That success led to further testing of digitizer assembly/digitizer clock components. A patch to provide a source-synchronous clock from digitizer assembly to formatter has improved reliability of parallel data transfer. Additional problems with stability of clocks between digitizer assembly and digitizer clock and with scrambled bits are being tested and studied. NA
- Continued testing of RFI performance to verify compliance with RFI analysis. NA
- Revisions to System Technical Requirements have not yet been received. BE electronic design to be shipped to Chile later this year is based on Rev A from 2004. NA and Euro
- The first 100 BE documents have been reviewed, approved, and released to the BE controlled document forum on EDM. NA and Euro
- The Quality Management program has been initiated in Socorro and the program used to identify and reject sub-standard vendor products.

5.2 Technical Status and Technical Performance Results Achieved over the Period

- Tests of the LO Photonics system, with 15 km of fiber cable and the antenna cable wrap in place, demonstrate a phase drift near project requirements when comparing the output of the Warm Multipliers with a Central LO reference. A similar test in Charlottesville demonstrated a phase noise within project specifications. NA
- The antenna fiber optic cable wrap works within specification: almost no measurable contribution to phase drift during motion. NA
- Tests of the DTS digital circuit boards, modified to use new optical transmitter and receiver components, demonstrate notably improved robustness over previous design. NA
- Vendor proposal for Master Laser and Laser Synthesizer identified important design improvements over the prototype modules, while offering the products at an acceptable price. NA

5.3 Highest Level Technical and Managerial Risks and Concerns

- Final Project System Technical Requirements have not yet been delivered. Changes to the BE requirements at this point may require design changes during the production cycle. NA and Euro
- A complete e2e test for BE has yet to be performed during Prototype System Integration tests: 1) Problems with integrating the digitizer assembly, digitizer clock, and DTS formatter remain to be fully identified and solved; 2) solutions to phase drift and phase noise in the 125 MHz LO Reference remain to be tested; and 3) Standards for CAN bus wiring, Monitor and Control hardware protocols, grounding, and power wiring have not been finalized. NA and Euro
- The vendor which provided the prototype IF processors has responded to an RFQ for pre-production units with a bid in excess of budgetary estimates. While the RFQ is negotiated or re-bid, prototype units can be used for antennas 1 – 3. The output filters have already been received from a separate vendor and are well within specification. An RFQ for gain equalizer circuits has been initiated in the event equalizers become necessary to meet revised project requirements NA

5.4 Planned Activities for Next Period (March - June 2006)

- Complete Acceptance Plans for pre-production modules. NA and Euro
- Complete verification testing for prototype SI. NA and Euro
- Finalize procurement documents for Master Laser, Laser Synthesizer, and Central Variable Reference. NA
- Identify and correct problems with 125 MHz LO Reference phase drift and noise. NA
- Install firmware modifications to 1st and 2nd LO synthesizers and DTS to eliminate Timing Event ambiguity on start-up. Initiate CREs for ICDs. NA
- Continue negotiating completion of external ICDs. NA and Euro
- Complete shipment of DTS de-formatters (new design) for one rack of 1st correlator quadrant when Correlator IPT solves timing problems with its filters. NA
- Review candidate modifications to digitizer assembly to provide remote tuning, test patterns, clock synchronization, and perhaps other updates; and initiate effort where practicable. Euro
- Full thermal characterization of the Digitizer and Digitizer Clock assemblies Euro
- Finalization of the AOS Technical Building anchoring system design and delivery to Site IPT. NA
- Start procurement process of the AOS internal fibre system Euro
- Delivery of pre-production Optical Mux-Demux/EDFA Euro
- If received, respond to NAOJ SoW for delivery of BE modules to ACA. NA and Euro
- If invited, prepare SoW for off-loading certain BE production work to ASIAA. NA
- Complete installation of over-temperature sensing and shutoff in prototype antenna racks. NA
- Continue conducting DTS digitizer assembly/digitizer clock/formatter system integration tests; identify and correct problems. NA and Euro
- Continue testing RFI performance to verify compliance with RFI analysis. NA
- Initiate design modifications, where necessary, when results of Project System Requirements Review (SRR) are complete and corresponding revisions to the System Technical Requirements are approved and released. NA and Euro
- Continue preparation of controlled production documents and internal ICDs. NA and Euro
- Schedule delivery of components for FEIC tests, antenna holography tests, and AIV 1st antenna tests if respective SoWs approved NA

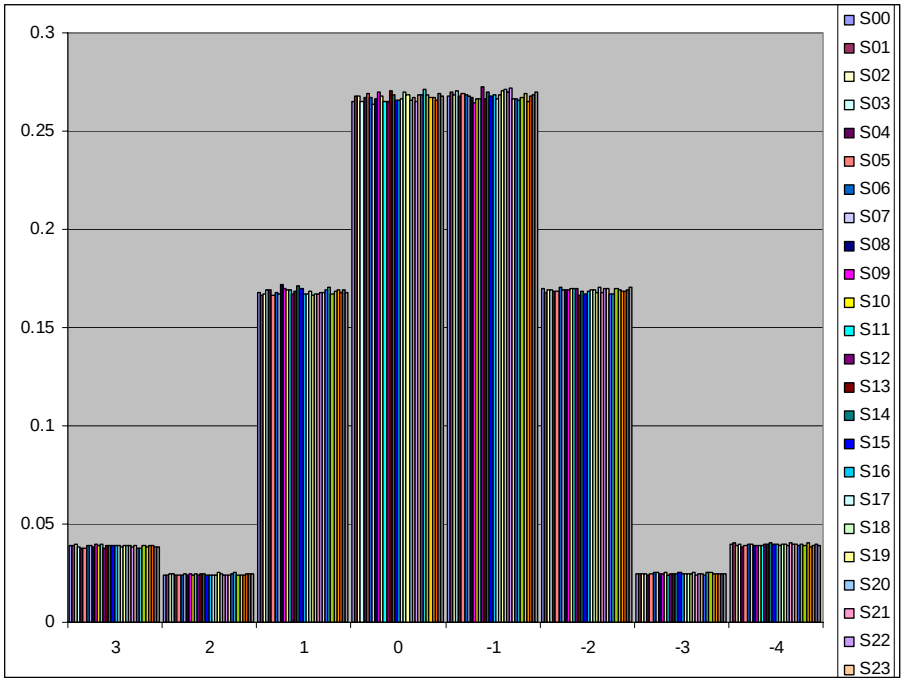

Figure 5-1 — Result of DTS and digitizer test conducted at Socorro in cooperation with Prototype System Integration: Plot of probability (vertical) versus 8 levels of digitization (horizontal) developed from data received at correlator. Plot demonstrates that digitizer is working and correlator is receiving data through Digital Transmission System.

5.5 Milestone Summary

Back End	9122	1.05.305	Deliver Back End Assembly, Test, & Verification Plan	Planned	30-Nov-04	Done	ESO & NRAO
Back End	9120	1.05.260. 0055	All NA BE Production Contracts Placed	Planned	1-Jan-05	5-Mar-07	NRAO
Back End		1.05.305	1st antenna racks (A & D) ready for shipment to OSF	Planned	15-Mar-05	1-Dec-06	ESO & NRAO

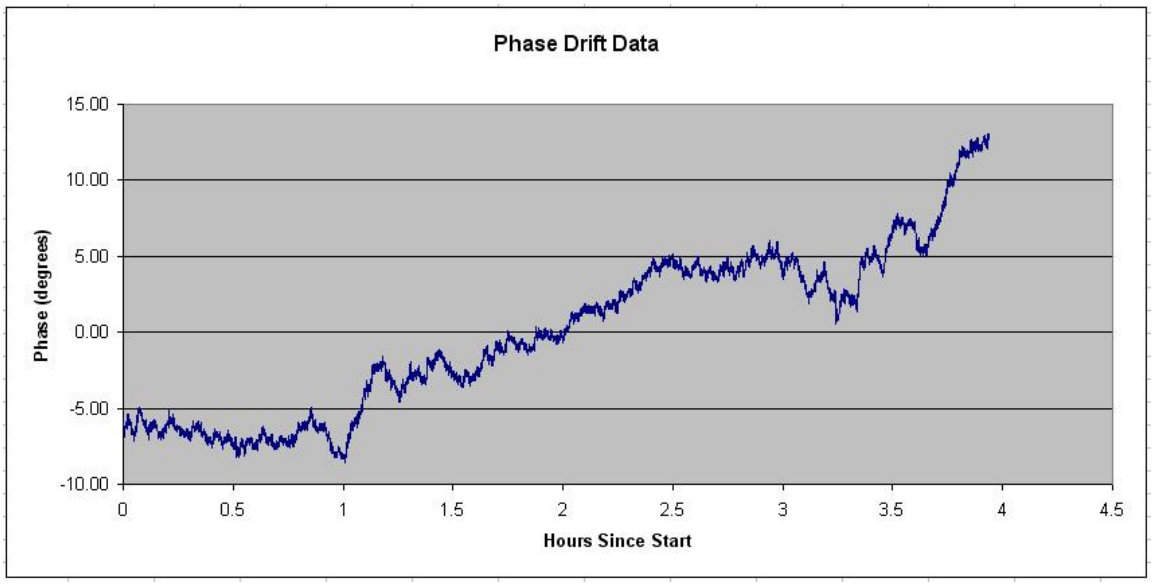

Figure 5-2 — Four-hour phase drift plot in an end-to-end test conducted at Socorro in cooperation with Prototype System Integration. The setup relayed the LO reference output of the Laser Synthesizer through one arm consisting of Line Length Corrector, 8 km of fiber spool, dual axis antenna fiber optic cable wrap, and Reference Receiver dichroic to a 1st LO Cartridge. The other arm, used as reference, relayed the output of the same Laser Synthesizer (split after the photonic distribution module) directly to the other 1st LO cartridge. The plot in the figure represents the measured phase difference between the two 1st LO cartridges phase-locked at 81 GHz. There are 50 intervals in the plot that meet the phase drift spec of 0.5 deg in 300 sec, an encouraging first system e2e effort. Shorter lengths of fiber cable outside the correction loop should help.

6 Correlator IPT

6.1 Overview

The Correlator is in an advanced state, and the part of the system supplied by U. de Bordeaux under contract with ESO (the European ALMA Executive), the Tunable Filter Bank cards, is being integrated into Quadrant 1 already. Responsibility for TFB firmware rests with U. de Bordeaux, as does production and testing. However, the integration task is a joint responsibility of U. de Bordeaux and the NRAO.

6.2 Achievements

The goals for the last reporting period were:

(1) Continue board testing in the background for the third and fourth quadrants as production boards are received;
(2) Continue burn-in of ALMA-1 chips and replace those which fail;
(3) Continue development of firmware and software;
(4) Complete at least one rack of Quadrant 2;
(5) Complete the test and acceptance plan;
(6) Continue testing the Stratix II version of the TFB card and make a decision about final selection of FPGA components for production.

The status of these goals is as follows:

(1) Accomplished (ongoing activity). All production boards have been received and nearly all have been tested for all 4 quadrants.
(2) Accomplished.
(3) Accomplished. Development and testing continues.
(4) Accomplished. All Station Racks and Correlator Racks for the second quadrant have been assembled and most of the wiring is in place.
(5) Not completed. This formal documentation task requires attention but has no practical effect on schedule or cost.
(6) Almost completed. A review of the TFB production plans is scheduled for 10-11 April in Bordeaux.

In addition, the following tasks were accomplished during January-March 2006:

(1) An extensive functional test of the Stratix II TFB card in Quadrant 1 of the correlator was conducted, with satisfactory results.
(2) A second Stratix II TFB card was completed and delivered for testing in Quadrant 1.
(3) A preliminary study of the temperature profile within the Station Racks was done and prepared for review at the 10-11 April TFB review meeting.
(4) Three data transmission system cards (DRX) were received from Back End and tested in Quadrant 1.

6.3 Status and Results

6.3.1 Procurement

Essentially, all the hardware has been completed except the following:

Integration and population of racks for Quadrant 2.
Assembly and integration of racks for Quadrants 3 and 4.

Production Tunable Filter Bank cards; prototype cards have been fabricated and tests are ongoing.

6.3.2 Delivery and Checkout

Of the 2551 production printed circuit boards of all types ordered, we have received all, including spares. Production TFB cards are not included.

2384 boards have successfully passed the initial set of tests in test fixtures; the remaining boards are in the queue for testing as time permits.

Board delivery and checkout is in a very satisfactory state.

6.3.3 Tunable Filter Bank (TFB) Development (U. de Bordeaux)

During the period, all remaining tests described in our Test Manual for Test Fixture have been passed successfully with the new Stratix II card design. The apparent difference in the I/O's currents for the Stratix I and II cards is now fully understood and is related to some dual purpose pins in one specific Stratix II I/O bank; this required a small modification in the VHDL code.

A major result concerns power dissipation which has been measured to be 78 W per filter card (our engineering goal was 100 W) with all 32 subchannels at work at 125 MHz; dissipation goes down to below 40 W in the bypass mode (original pure XF correlator mode).

Two Stratix II cards have been delivered to the NTC in Charlottesville and successfully tested in the first Quadrant of the Correlator. Test reports on tests with the Test Fixture and in Quadrant 1 have been prepared.

The final date and initial documentation for the Production TFB Card review of April have been defined and prepared.

6.4 Highest Level Risks and Concerns

There are, at present, no major concerns.

6.5 Planned Activities for Next Period

The goals for April-June 2006 are:

(1) Continue board testing in the background for the third and fourth quadrants;
(2) Continue burn-in of ALMA-1 chips and replace those which fail;

(3) Continue development of firmware and software;
(4) Hold TFB review meeting and take decision on final selection of filter chips;
(5) ESO and U. de Bordeaux finalize production contract for Production TFB cards;
(6) Receive from Back End, install, and test a full rack of DRX cards;
(7) Measure temperatures and, if necessary, modify air flow within the Station and Correlator Racks to smooth heat removal;
(8) Complete the test and acceptance plan;
(9) Move Quadrant 2 into the correlator test room and begin populating racks;
(10) Review readiness of Quadrant 1 for shipping.

6.6 Milestone Summary

Regular milestone updates are always current in the Integrated Project Schedule.

Quadrant 1 is expected to be ready for disassembly and shipping in June 2006. Disassembly was expected to be necessary by the end of July 2006 in order to free space for assembly of Quadrant 3; however, it may be possible to postpone this for some months while rack construction for Quadrant 3 is done in the lab adjacent to the correlator test room.

7 Computing IPT

7.1 Accomplishments this Period

7.1.1 Whole IPT

- Conducted an internal user test of the Optical Pointing observatory mode at the ATF. For the first time ever, an integrated (observing tool to archive) ALMA Computing system was used in other than a simulation mode. The test was generally successful, resulting in a punch-list, although bad weather at the ATF meant that only a few pointing terms were determined.
- The ALMA Software Stability Initiative concluded. This was an effort to refactor the existing code and to improve test coverage, particularly by adding multi-subsystem regression tests.
- Completed the software for the R3.1 check-in, which happened at the end of the period. The integration period is scheduled to conclude in the next period. It is expected that due to the work on the first two items the integration period should be shorter than scheduled (2 months).
- Started work on a "Shared Simulator" for interferometry. This simulator, unlike previous simulators, provides simulation in which the hardware devices are coupled, rather than running independently, and will result in realistic (although still simple) ASDM data.
- Continued supporting the ATF for other IPTs (for example, the Antenna IPT) and the PSI work at the AOC.

7.1.2 CIPT Management

- Participated in NSF Cost/Management Review (NA only), provided material for Delta (2-antenna) Cost Review, and presented material to the ESAC and ASAC.
- Organized discussions of Chilean IT matters in preparation for JAO IT manager.
- Made proposal for parametric cuts to NA management.

7.1.3 ALMA Common Software (ACS)

- Release two patches (5.0.1 and 5.0.2) to improve various issues found with the ACS 5.0 release. Most notably the robustness and interface for threading were significantly improved. This latter was largely an EU activity.
- In response to the optical pointing test, improved the logging system and GUI. This was an EU activity.
- Worked with the control team to improve test coverage.

7.1.4 Archive Subsystem (all items EU)

- Created a command line interface to retrieve ASDM datasets.

7.1.5 Control Subsystem

- Completed data capture modifications for optical pointing (which now produces TPOINT files from ASDM, hence normalizing optical pointing within the system). (NA)
- Concluded implementation of a first version of the Control Command Language in support of optical pointing. (NA)

- Implemented additional metrology interface support for both antennas, and provided support under the new RTOS for the AEC antenna. (EU).
- Worked on regression test suite to validate new single board computers. This will be important shortly, as a new generation of SBCs will have to be purchased for Chile (the current systems are obsolete).
- Tested several back end devices as part of PSI activities (e.g., completed testing of 2nd LO, including phase coherent frequency testing). (NA).
- Led the optical pointing functional team (NA).
- Implemented first version of entire-system frequency tuning algorithm (NA).

7.1.6 Correlator Software (All NA)

- Verified via simulation that the correlator data processor produces correct spectral points (from lags) to (at least) the 0.3% level.
- Revised the correlator output binary data structures to match the latest ASDM definitions, and tested sending it via the bulk receiver component.
- Converted engineering correlator GUI from Python to Java.
- Supported TFB testing.

7.1.7 Executive Software Subsystem (All EU)

- Improved the operator master client startup and monitoring functions, and implemented a panel for queue scheduling.

7.1.8 High Level Analyses

- Organized and led the software stability initiative and shared simulator functional teams (EU).
- Ported APDM to UML2, Magic Draw 10.5, and version 4 of the Open Architectureware code generation framework. (EU)

7.1.9 Integration, Test, Support

- Provided extensive support for the ATF (NA) and in support of the software stability initiative (EU).
- Investigated local flash memory products and network file protocols to reduce latency and improve reliability of file access at the AOS. This will become important in 2008.

7.1.10 Observatory Operations Support Software

- Worked on initial design concept. (EU)

7.1.11 Observing Preparation and Support (EU)

- Prepared a first version of a visual spatial editor for comment.
- Introduced infrastructure for "wizards" to guide creation of observing program, with first implementation for optical pointing.

7.1.12 Offline Subsystem

- The first Python user interface for CASA was exposed to users via an external user test and with a week-long UI focus group meeting. (NA)
- Completed a filler of the ASDM into the CASA internal data format (EU).
- Implemented single-baseline commissioning functionality (this differs from normal processing in that calibration values cannot be antenna based). (NA)

7.1.13 Pipeline Subsystem

- Flagging and calibration heuristics were completed and sent to external user test.
- Initial single dish baseline fitting heuristics.
- Improved GUI infrastructure for quicklook displays was prepared. (NA)

7.1.14 Scheduling Subsystem (NA)

- Queue scheduling was implemented.
- User test of planning mode simulator.

7.1.15 Science Software Requirements Committee

- Led the testing and evaluation of the optical pointing system (the test team consisted of four SSR members).
- Provided use cases to drive development of optical pointing (NA), and shared simulator (EU).

7.1.16 Software Engineering

- Began study of refactoring the make system – the current system is very complicated, but it is not clear that refactoring it would be worth the cost.

7.1.17 Telescope Calibration Subsystem (EU)

- Tested the side band ratio calculation engine.
- We are now able to interconvert ASDM and IRAM interferometer data for testing purposes.

7.2 Activities Next Period

- R3.1 integration concluded. It is expected to go much more easily than for previous integrations.
- CDR4 review of planning and selected technical topics. This review will largely be internal to Computing.
- Punchlist from optical pointing implemented.
- Holography observing mode functional group started.
- Monitor point database (re)implementation and APDM refactoring functional teams started and concluded.
- Complete level 2&4 testing of available PSI devices; support PSI in general.

8 System Engineering & Integration IPT

8.1 Management

- The main management activities were interfacing with the JAO, the executive PM, and the IPT management and reporting planning of the next activities and updating the ALMA risk register.

8.2 Engineering

8.2.1 Requirements and ICDs

- No additional project level requirements were approved and the completion status remains at 91%.
- Two additional project level ICDs were approved and the completion status is 79%.
- The planning of the System Requirement Review is in progress. A plan was prepared and distributed. It was decided to do a series of telecons instead of a single face-to-face meeting. It will be split into:
  - Closing the AI from the last meeting and updating the system requirements document.
  - Ensure completeness of operation requirements which affect the construction project provide the linkage.
  - Include software operation and software control requirements in the SRR process.
  - Include ACA performance and operation requirements in the SRR process.

  In addition a meeting will take place 24 and 25 April in Garching.

8.2.2 Design and Analysis

- SE&I IPT participated and/or chaired the following technical meetings:
  - Antenna Progress meeting
  - Band 7 Preliminary Acceptance in house (PAI) for the first cartridge
- The system performance budgets were further detailed and updated with Front End and Back End test results.
- The preparation of the 3-dimensional model of the AEM antenna receiver cabin with its interior has been started. An update to the Vertex receiver cabin layout was prepared.
- Support was given to the Front End IPT to prepare a Front End Support Structure (FESS) analysis and to conclude on the design. Instead of a FESS made out of Invar, Steel will be used as FESS material, which reduces the costs significantly.
- The mechanical tolerance budget was further developed and refined.
- The ALMA master frequency standard MFS unit was configured based on a Symmetricom configurable clock. Additional support to Back End was provided in procuring this device.
- The AOS power budget was updated and the associated document updated.
- The cryostat concluding CDR planning is in progress. Together with Front End IPT and RAL, the SE team is working on the closure of the remaining action items.

- Cabling plan for ALMA equipment on the Vertex and AEM antennas was prepared and distributed.

8.2.3 Configuration Control and Documentation Management

- CCB secretary changed from Christoph Haupt to Rick Murowinski.
- One CCB meeting took place. Three ICDs and five Change Requests were approved.
- No progress on the CMMS procurement, but the specification and SoW should be finalized by end of June.

8.3 Product Assurance

- No progress was made on the reliability calculations. Other PA activities are being covered by SE personnel at the Band 7 PAI and at the antenna progress meetings, until a new ALMA PA is recruited.

8.4 Prototype System Integration

- In the lab, the Vertex rack rewiring task has been completed. There are now two pairs of antenna racks and bins ready for use. Checkout of modules continues.

- After firmware changes on the Data Transmission System transmitter board, the bit error rate in the full DTS is acceptable. Attention is now on the data flow from an analogue input to the digitizer through to the correlator. The relative delay of digitizer, demux, and formatter clocks, plus the digitizer offset and range adjustments all impact the state distribution as seen in the correlator. These adjustments and their stability are being investigated.
- The problem of the spontaneous reboot of the AEM antenna ACU is understood and largely resolved by replacing corroded connectors on the AMB cables. A problem remains that when the ABM is in a suspended state and when it is turned on or off, the ACU reboots; a correction to this problem involves small changes on the ACU reset board. These changes have been tested and accepted by AEM.

- Photonic LO – The Master Laser in the PSI Central LO at the AOC has had increasing difficulty obtaining and holding wavelength lock. Staff from ALMA and an engineer from the vendor Teraxion worked on this unit. It was found that the optical frequency doubler was not able to adjust to its optimal temperature owing to a software limit and that a dirty switch was causing unstable temperature control of the fiber laser. Correcting these problems plus a re-alignment of the optics brought this unit back to expected performance.

- Two Line length Correctors (LLC) and their connecting fixture were inserted in the optical path of the LO sub-system. Characterization of the sub-system phase drift has begun and show encouraging results.

- Data Transmission System (DTS) – There is growing certainty that the spectral line distortion seen at the correlator output arises from bits being improperly rearranged somewhere in the DTS chain. When a signal generator is used to insert a spectral line at the digitizer, at some frequencies the output spectrum shows a beautiful narrow line, but at other frequencies the line

is broken into numerous peaks. The DTS involves many stages of formatting, multiplexing, and demultiplexing the bit stream. A software simulation shows that if a 32 bit group of data is time reversed, the observed distorted pattern can be accurately reproduced. But the problem is to identify where in the DTS chain this error is introduced. The DTS modules are back in the hands of the BEND engineers for investigation of the firmware.

- LO sub-system – excessive phase drift in the 125 MHz reference signals in the antenna racks was investigated. The problem was caused by low intensity of the optical reference to the LORR module. This in turn changed the operating point of a X5 multiplier which made the output phase a function of intensity. Cleaning fiber connectors and adding a 25 MHz amplifier greatly improved the phase stability. The relationship between LORR 125 MHz phase and input optical intensity will be characterized.

8.5 Chilean System Integration Planning

- Chilean AIV planning continued through discussions with the antenna IPT about acceptance and verification of the antennas and through first talks with Japan about the integration of ACA into ALMA bilateral AIV planning.
- Planning continued for the infrastructure and equipment needed for first antenna acceptance tests and AIV, in Chile. In particular, an interim lab has been designed which will allow AT and AIV work to progress in spite of the late delivery of the OSF Technical Facility, and that lab is now being contracted by Site for delivery on schedule.

- Detailed planning for the holography system, led by Emerson, had given Site IPT the location of a first holography transmitter tower and has organized the development, integration, and test of the holography subsystem, scheduled for delivery to Chile in time for first acceptance tests.

- ALMA Board approval was granted for three temporary AIV hires in advance of the AUI local hiring policy being in place. Two of those temporary hires have been selected. Interviews for the first group of Local Staff for AIV are scheduled for June.

9 Science IPT

9.1 Overview

During the period January through March 2006, the JAO Project Scientist turno system continued. Under this system, one of the three regional project scientists perform the duties of the JAO Project Scientist for a period of four months, during which they spend at least three weeks in the Santiago JAO office. Wilson served nearly 3 weeks in Santiago during Feb-March. The stay was shortened by the need to be at meetings in Europe. He will return in May-June to finish his time as JAO Project Scientist in Santiago. The Science IPT assisted the ASAC in responding to its Charges from the ALMA Board. The Science IPT leadership attended the ALMA Delta Cost Review in Washington, where Wootten made presentations on Science Impact of Two Antenna Designs and on the Science IPT. Wootten also made presentations for the NSF Cost/Management Review for ALMA North America on 30 January. The Project Scientists and Instrument Scientists also served on the follow-up working group for the System Requirements Review (SRR); the follow-up meeting is scheduled for April 2006. Wootten, Wilson, and Kawabe serve on the new Operations Working Group, which has not met during this Quarter. During the quarter, A. Remijan jointed the Science IPT in North America as a postdoctoral researcher.

9.2 Scientific Advisory Committees

As planned, the Science IPT facilitated the ASAC face-to-face meeting in College Park, Maryland, and its report to the Board in Kyoto, providing supporting documents, an agenda, and presentations. Several ANASAC, ESAC and JSAC telecons were held. New ANASAC members included: Chris Carilli (NRAO), Todd Clancy (SSI), Terry Herter (Cornell), Kelsey Johnson (UVa), Elizabeth Lada (UFla) and Alycia Weinberger (DTM). New members of the ESAC are F. Gueth (France) and M. Hogerheijde (Netherlands).

9.3 Technical Status and Technical Performance Results Achieved

All Science IPT goals are on schedule and on cost. For North American, a quantitative estimate is available in the Earned Value Management System (EVMS) reports, in which Science IPT parameters are deemed reasonable.

9.3.1 Configuration, Antennas

The Science IPT provided an assessment of the Science Impact of Multiple Antenna Designs on ALMA.

A design for the configuration of the innermost (within 4km) station locations was submitted in August 2005. A strawman design for the outermost station locations was also submitted. This will be iterated with the design for the road and fiber network during the coming quarter to achieve a design which is scientifically robust while minimizing road and fiber network costs.

Emerson led a series of telecons to provide plans for holography in Chile. Plans have been developed to move weather stations from the site characterization containers at Chajnantor to the OSF to support holography and pointing on the production antennas.

A series of papers have been submitted describing the testing done by the Antenna Evaluation Group on the prototype antennas.

9.3.2 Calibration

Specifications for the instruments needed to provide the atmospheric information necessary for effective scheduling and accurate calibration of ALMA are being drafted, following the recommendations SCID-90.05.13.00-001-A-SPE. Mangum assigned calibration examples to be written, as a result of the system requirements review. Most have been drafted and are available on the calibration wiki page.

Hills has analyzed recent data from the prototype Water Vapor Radiometers (WVRs) operating at 183 GHz which were installed on two of the antennas of the Smithsonian Submillimeter Array (SMA) on Mauna Kea. A preliminary analysis was done by the MRAO group and reported by Hills. Despite extremely poor weather (3-4 mm of precipitable water vapor along the line of sight), this data showed excellent agreement (correlation coefficient better than 0.9) between the emission seen by the WVR and the interferometric phase at 230 GHz toward 3C279 moving down at night from ~30 to ~20 degrees elevation on a 200m baseline at 230 GHz. The agreement shown between WVR and interferometric phase was superior to that yet demonstrated anywhere.

9.3.3 Imaging

Crystal Brogan (NAASC/NRAO), Steve Myers, Kumar Golap, and Mark Holdaway (NRAO) discussed an Aips++/CASA simulation of ALMA with 50 antennas in the compact configuration (< 100 m) at the URSI/NA meeting in January. This 100 GHz 7 x 7 pointing mosaic was generated from a track covering +/- 2hrs from the meridian. In traditional mosaicking, one co-adds weighted images made by transforming individual pointings (e.g., as facets). However, one can grid all the data onto a large over-sampled uv grid (with sub-aperture resolution) using a gridding convolution function given by the aperture cross-correlation function (the transform of a single-pointing primary beam) and then transforming to the image plane (e.g., Myers et al. 2003). This procedure was demonstrated using an image from Spitzer, including ACA and single- dish information.

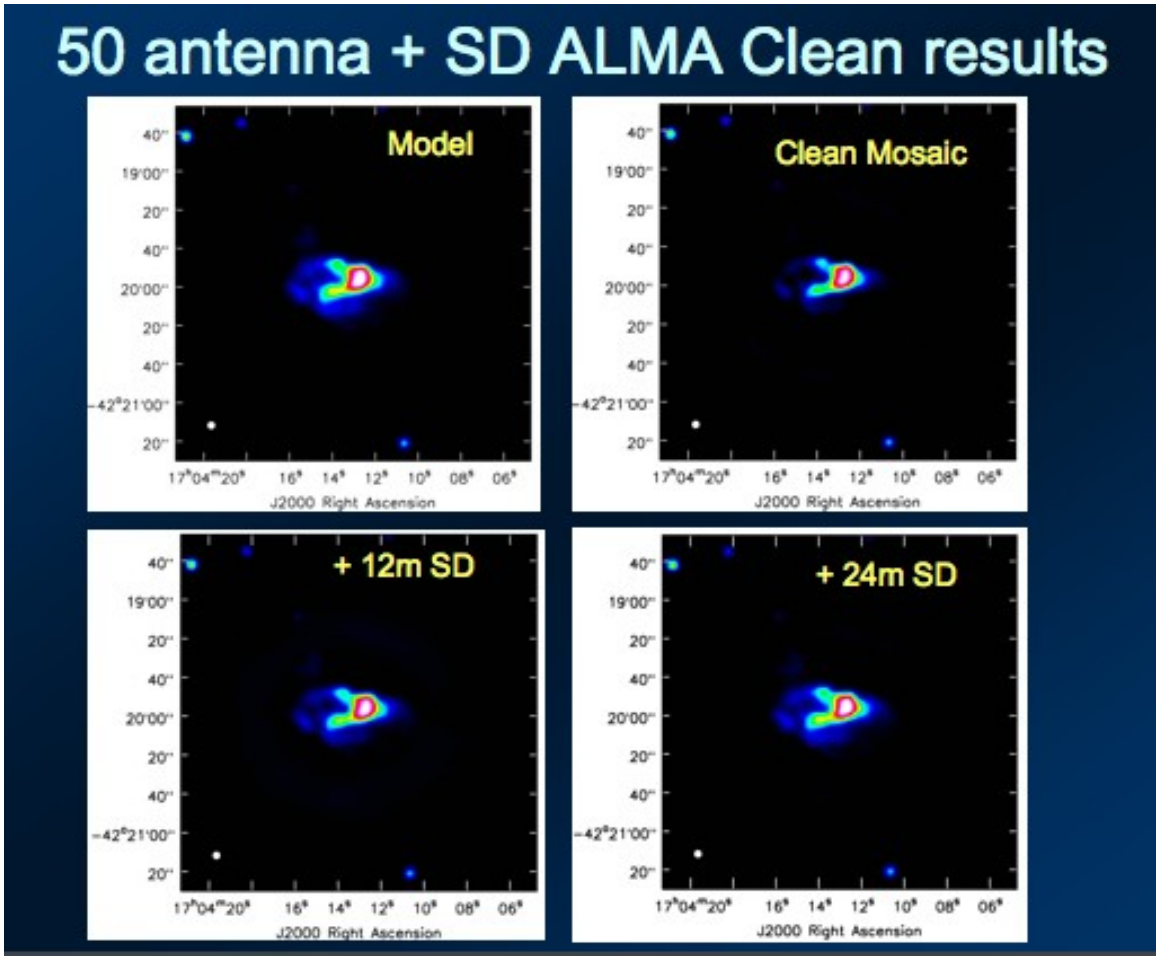

Figure 9-4 Results from new gridding convolution algorithm.

9.3.4 Site Characterization

This activity was closed on 1 January 2006. The instruments remain, in an unknown state, in and near the containers on Chajnantor.

One memo relating to ALMA Site Characterization appeared. ALMA Memo No. 541, by Alison Stirling, Angel Otarola, Roberto Rivera, and Juan Bravo, reports on the August 2005 observing campaign that was conducted to measure the horizontal variability in the temperature profile above the Chajnantor site. The temperature profile is known to affect pointing and phase corrections, as well as amplitude calibrations, so knowledge of the likely variation in temperature is essential for planning ancillary meteorological equipment for the site. The authors found that pointing errors introduced by using a temperature profile from a different part of the Chajnantor site are of order 0.3" at an elevation of 60 degrees. Path errors introduced as a result of using the distant temperature profile are of order 2%.

An internal document (SCID-90.05.13.00-002-A-REP) on the distribution of small windborne particles on Chajnantor was written by A. Otarola.

9.4 Science Requirements

The ALMA Science Requirements were approved by the CCB in June 2005. Comments received from the System Requirements Review in July 2005 and from the ASAC were addressed in a new version submitted in December. Subsequently, some items in the Science Requirements document have been included in the System Requirements document and may be removed from the Science Requirements document. This process will be completed at the follow-up System Requirements Review in April 2006.

9.5 Organization, Interaction with Other IPTs

Tom Wilson arranged for final versions of contracts and money transfers to participants for FP 6 'ALMA Enhancement' sponsored by EC for six Band 5 receivers.

Telecons were held with other IPTs on a number of issues, including Frequency Switching requirements, requirements for Holography at the OSF, and Nutator requirements. Ocampo and Grubb, from the PMCS group, met often with Wilson and with Wootten to discuss Science IPT organization in preparation for Cost Reviews. Science IPT members continue to contribute to software testing and to the SSR.

9.6 Meetings, Outreach and Public Education

Several ALMA talks were presented at the North American URSI meeting and at the AAS. The ALMA presence at the IAU is being coordinated. An ALMA workshop on "From Z-Machines to ALMA: (Sub)millimeter Spectroscopy of Galaxies" was be held 13-14 January 2006 at NRAO-CV. There were about 80 registered participants; presentations are available at the NAASC website and the conference Proceedings are being edited.

Meetings at which ALMA was represented include:

- National Radio Science Meeting 4-7 January, Boulder, Colorado
- ALMA Town Meeting, 9 January, Washington, DC
- From ZMachines to ALMA, 13-14 January, Charlottesville, VA
- Subaru-ALMA Science Working Group, 2-3 March, Hilo, HI
- American Chemical Society - Special Session on Astrochemistry 26-30 March, Atlanta, GA
- GAJapanese Astronomical Society – Special session on ALMA 2006 March 29

There was one ALMA workshop:

- From ZMachines to ALMA 13-14 January, Charlottesville, VA

Planning occurred for future meetings, including :

- Complex Molecules in Space: Present Status and Prospects with ALMA, May 8 to 11, 2006, Fuglsoecentret, near Aarhus, Denmark
- Making the Most of the Great Observatories, May 22-24, 2006, Pasadena, CA
- The Red Rectangle, May 23-25, Charlottesville, Virginia
- SPIE, 24-31 May, Orlando, Florida
- ALMA Special Session AAS/CASCA, 4-8 June, Calgary
- Coalition for National Science Funding Hill Exhibition, 7 June, Rayburn House Office Building, Washington, DC.

- 61st OSU International Symposium on Molecular Spectroscopy, June 19-23, 2006, Columbus, Ohio
- The Fate of Gas in Galaxies, July 12-14, 2006 ASTRON, Dwingeloo,
- IAU XXVI General Assembly Prague, 14-25 August 2006
- Science with the Atacama Large Millimeter Array (ALMA) II November 13-16; Madrid, Spain

9.7 Highest Level Technical and Managerial Risks and Concerns

Issue	Probability Score	Impact Score	Risk Exposure	Category
ALMA Performance fails to reach science requirements	1	5	5	Medium
ALMA consists of only 50 antennas	3	2	6	Medium
ALMA consists of only 40 antennas	2	5	10	High
Phase mitigation techniques fail to meet spec	1	5	5	Medium
WVR phase mitigation techniques fail to meet spec	2	2	4	Medium
FS phase mitigation techniques fail to meet spec	1	2	2	Low

9.8 Planned Activities for Next Period

Manpower – No manpower changes are planned during April and June 2006. During the latter months of this period, the JAO Project Scientist role will transition from Tom Wilson to Ryohei Kawabe.

Site Characterization – Weather stations will be redeployed from the site characterization containers to the OSF to support production antenna holography and pointing. Analysis of existing data by former employees may result in further memos which are needed to develop the optimal procedure for phase correction of data using fast switching and the WVRs.

Configuration – Holdaway will complete the redesign of the ALMA configuration beyond 4km radius for fifty antennas, with provision for placing 64 antennas, should that number become available. 'Ground truthing' of this array will be accomplished by Holdaway and Otarola. This was not accomplished as planned during 2006 Q1, as road and fiber network planning had not progressed sufficiently to allow it.

Calibration – The MRAO group will continue to analyze data from the prototype WVRs, which continue to be deployed at the SMA for the first part of the period, at least. The draft ICD between the computing IPT and the weather stations will be finished during this quarter.

Imaging – Polarization and mosaicking with multiple antenna designs will be simulated late in this quarter and into the following quarters of 2006. Specifications proposed by the Front End IPT for the quarter wave plate are under analysis to determine if they can meet the ALMA science requirements. This study will appear in April. Simulations of ALMA observations of targets of interest for Sunyaev-Zeldovitch effect studies will be completed. A study of radiometric seeing reporting tests done with the prototype ALMA antennas, by Holdaway, Mangum and Lucas, will be finished. Participation by Science IPT members in Computing IPT software testing will continue.

Outreach – During 2006 Q2, a workshop will be held on Complex Molecules in Space: Present Status and Prospects with ALMA at Fuglsoecentret, near Aarhus, Denmark , 8-11 May 2006,. Beasley will represent ALMA at 'Future Directions for Millimetre Astronomy in the Southern Hemisphere' to be held at Chowder Bay, Sydney Harbour on 30 - 31 March 2006 and at SPIE 24-31 May, Orlando, Florida.