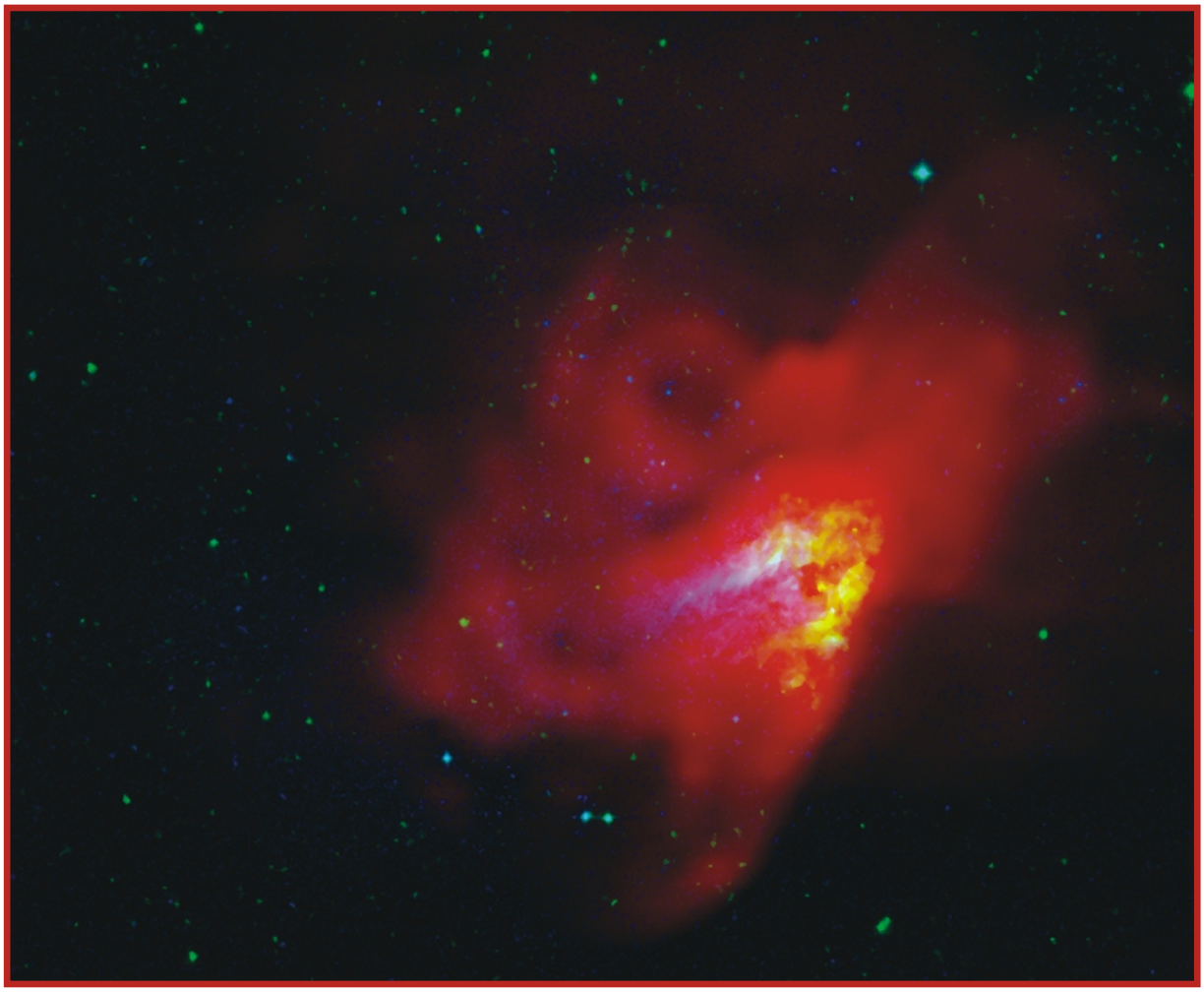
National Radio Astronomy Observatory



Quarterly Report

April – June 2006

NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

APRIL – JUNE 2006

Cover Image: Radio (red), infrared (green), and optical (blue) emission from the HII region M17. The radio source is much larger because most of the optical emission has been absorbed by foreground dust transparent to radio waves. Image courtesy of: Frank Ghigo, Ron Maddalena, Glen Langston and Toney Minter (NRAO).

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EXECUTIVE SUMMARY

Expanded Very Large Array (EVLA)

EVLA Antennas 13, 14, 16, and 18 are functioning with four IFs. EVLA Antenna 24 recorded its first fringes using two IFs at X-Band, and the mechanical overhaul of antenna 26 is nearly complete. The EVLA Advisory Committee reviewed the project on May 8–9, and an NSF Mid-Project Review was held on May 11–12. The critical design review of EVLA front-end systems was held on April 24–25. A design for the prototype of the 3-bit 4-GHz sampler has been completed. The delivery of the correlator baseline boards has been delayed by a subcontractor's fabrication error. Monitor and control software for the antenna utility modules was developed. The first software for the Observation Preparation Tool was released.

New Initiatives Office

The NRAO is evaluating the feasibility of hosting the International SKA Project office in Charlottesville. The first 16 elements of the Long Wavelength Demonstrator Array prototype station have been successfully installed at the VLA site. Progress on the design and development of the FASR has been limited by the delays in receiving NSF funding. Discussions are beginning with Japanese radio astronomers for participation in the recently approved VSOP-2 space-VLBI project.

Green Bank Telescope (GBT)

On May 31 the high-frequency observing season ended and the summer extended maintenance periods began. The Ka-Band (26–40 GHz) and Q-Band (40–50 GHz) receivers have been removed from the telescope for planned refurbishments, upgrades, and diagnosis of spectral-baseline problems. This work is proceeding well, aided by the conversion of the ALMA prototype correlator to a GBT lab spectrometer. Telescope structural inspections and painting are on schedule.

Management activity included participation in the NRAO Users Committee and Visiting Committee meetings and the NRAO Legacy Workshop, plus a major review of GBT projects and priorities in advance of developing the Green Bank contributions to the FY07 budget request and program plan. Significant project accomplishments include the first draft of a proposal for dynamic scheduling and good progress towards commissioning the Zpectrometer wideband spectrometer. The GBT azimuth-track refurbishment project remains on schedule for the summer of 2007.

Very Large Array (VLA)

The azimuth bearing on antenna 26 was removed and replaced, making this the 11th VLA antenna to have its bearing replaced. Since we have only one emergency spare, three of the recently removed bearings have been sent out for refurbishment. Antenna 26 is now undergoing an EVLA retrofit, so the array now has 22 VLA antennas and six in various stages of EVLA retrofit. We expect at least four of the EVLA antennas will be returned to scientific observations by default during the third quarter. Late in the second quarter, the SAO terminated their program to outfit VLA antennas at 190 MHz in order to detect HI from the epoch of reionization. All VLA proposals submitted at the June proposal deadline used the new web-based proposal submission tool.

Very Long Baseline Array (VLBA)

The first of the year's major-overhaul "tiger team" visits was made to the Kitt Peak VLBA antenna. All parts of the antenna structure were found to be in excellent condition. The VLBA has completed its conversion to recording full-time on the Mark 5 disk-based system, with the exception of a few stations that use tape when data from several foreign stations must be ingested on disk media. The 10th Aperture Synthesis Imaging Summer School was held in June with a record number of 170 attendees.

North American ALMA Science Center (NAASC)

Work concentrated this quarter on preparing for an internal review of the NAASC Operations Plan scheduled for April and developing a bottom-up WBS for the division for 2006–2013, in preparation for a budget presentation to NSF on April 24. The North American ALMA Regional Center (ARC) Manager worked with the JAO on modifications to the ALMA Operations Plan to include the ALMA Compact Array and unresolved issues, in preparation for the ALMA Board meeting in mid June. A revised operations plan is due by the November 2006 Board meeting, with a revised budget available by the August Board telecon. These are primary milestones for Q3 and Q4.

NAASC operations planning continued with several meetings and telecons with personnel from the NRC and with the NRAO e2e Opertions Division to discuss the ALMA Archive and Virtual Observatory (VO) work. NAASC personnel organized and conducted an ALMA Special Session at the AAS meeting in Calgary on June 5–9 2006. Planning for the next NAASC workshop was started. The ANASAC met twice during this period. Three articles were submitted for the July NRAO Newsletter.

Central Development Laboratory (CDL)

Good progress was made in designing low-noise amplifiers for the new EVLA receivers: the 12–18 GHz amplifier was redsigned to achieve a wider noise and gain performance and the prototype 5–20 GHz amplifier was successfully tested. A total of 20 amplifiers were built or upgraded for the EVLA and the GBT. Several new MMIC design projects have been started, and good progress has been achieved in the development of GaAs pHEMT power amplifiers. Development of advanced SIS mixers for frequencies above 700 GHz made good progress with the fabrication of the first NbTiN trilayer (NbTiN/AlN/Nb) at the UVa Microfabrication Laboratory. The design of a 211–275 GHz balanced mixer incorporating a superconducting hybrid was completed. A half-size prototype of the EVLA 2–4 GHz feed was fabricated for the 4–8 GHz band and tested. Design of an 84–106 GHz phase shifter is in progress.

The Green Bank Solar Radio Burst Spectrometer continues to observe the Sun; the GB/SRBS Phase II was completed. The FASR engineering R&D planning document has been completed. Work on refining the scientific objectives for the instrument, translating these objectives into engineering requirements, and exploring various design alternatives continued. Work on the Precision Array to Probe the Epoch of Reionization (PAPER) for measuring the predicted step in the cosmic microwave background due to neutral hydrogen at the epoch of reionization is in progress. The proposal to support efforts for a larger array in Western Australia received partial support from the NSF AST Grants Program, and an eight-element array will be built.

Chile

Following the decision that AUI/NRAO will act as the sole employer of Chilean local staff for ALMA on behalf of the international collaboration, a Head of HR for ALMA, Mr. Alvaro Leiva, was hired and will start his work at El Golf on 19 July. A basic set of HR-related documents was approved by ALMA and sent for approval to the NSF.

Business support for ALMA construction in Chile continues, with a number of work packages completed, including the Array Operations Site (AOS) Technical Building (TB) Foundation and Shell Package and the ALMA Recreation room at the Operations Support Facility (OSF). Others have been started, such as the Completion package for the AOS TB.

e2e Operations Division

The e2e Operations Division was established on April 3, 2006. Efforts have focused on building the organization, outlining roles and responsibilities, identifying startup funding, building channels of communication, and determining strategies for action in the Division's initial year.

The focal activities during FY07 will be establishing an active presence within the emerging National Virtual Observatory (NVO) facility, ensuring that science products are available for much of the existing archived data from NRAO telescopes, making the archived data easier to access, and making more extensive use of NVO protocols and services. The second priority effort is to bind existing pipeline services to the archive in order to broaden access. The proposal submission tool will also begin a transition to the e2e Operations Division in the fall of 2006.

Our plans can be expected to evolve as they grow and are continually improved and refined over the upcoming months.

Computer and Information Services (CIS)

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 service complements the one already provided to access information available to external users and the general public. It was so successful that we decided to double its capacity, so that all internal resources are searchable. The central disk filer in Charlottesville has been upgraded to allow faster access and increased storage (1.4 Terabytes expandable) for general usage. There was only one formal security incident during this quarter. It was of lowest possible severity and there was no compromise.

Education and Public Outreach (EPO)

Detailed proposals for international, Chilean, North American, and AUI/NRAO ALMA EPO were generated and reviewed. Though nine potential bidders were cultivated for the World-Wide Web (WWW) Request for Quote (RFQ), only one proposal was received, and the review committee decided not to fund it. An alternate course of action for hiring and webmaster and engaging a contractor in WWW

renovation are being defined. Design work for a new general-public brochure continued, though the decision to engage an external graphic-design firm has lengthened the schedule. Based on internal and external (Users Committee) input, plans for a hardcopy brochure for the professional astronomical community have been shelved in favor of the WWW. Three teachers accepted appointments to the 2006 NRAO Research Experiences for Teachers program. EPO staffed and managed the NRAO exhibits at the summer American Astronomical Society (AAS) meeting in Calgary. Preparation continued for the NRAO and ALMA exhibits at the International Astronomical Union (IAU) General Assembly in Prague. Compared to 2005, April–June visitation increased by 4.6% at the GB Science Center but decreased by 7.5% at the VLA Visitor Center.

SCIENCE

1. SCIENCE HIGHLIGHTS

Very Long Baseline Array

VLBA Reveals Closest Pair of Supermassive Black Holes - Multi-frequency observations of the radio galaxy 0402+379 with the VLBA revealed two compact, variable, flat-spectrum active nuclei within this elliptical galaxy at redshift $z = 0.055$. The two nuclei represent the closest pair of supermassive black holes yet found, separated by only 7.3 pc, more than two orders of magnitude closer than any previously discovered pair. With a combined mass of 1.5×10^8 solar masses, this pair, were they to collide, would produce strong gravitational radiation. It is estimated that they will collide in no less than about 10^{18} years, if the orbit decays only due to emission of gravitational radiation.

Investigators: C. Rodriguez and G.B. Taylor (UNM), R.T. Zavala (USNO), A.B. Peck (CfA), L.K. Pollack (UC Santa Cruz), and R.W. Romani (Stanford).

Green Bank

Radio Observations of a Remarkable Anomalous X-ray Pulsar - Anomalous X-ray pulsars are neutron stars with X-ray luminosities exceeding the energy available from braking of the star's rotation, and likely generated by decay of extremely strong magnetic fields. They normally show no radio emission. Three years ago the anomalous X-ray pulsar XTE J1810–197 increased its X-ray luminosity by a factor of 100 and, a year later, was detected as a radio source at the VLA. It has recently been detected as a radio pulsar at Parkes and its properties measured at a number of frequencies with the GBT. It is a remarkable object, with relatively strong pulses visible up to 42 GHz; its radio spectrum is quite flat over a range of 100 in frequency, and above 20 GHz it is brighter than every other known neutron star. Observations of single pulses with the GBT at 42 GHz show a complex pulse structure with features as narrow as 0.2 milliseconds. The radio emission mechanism is unknown.

Investigators: F. Camilo (Columbia Univ.), S.M.Ranson (NRAO), J.P. Halpern (Columbia), J. Reynolds (ATNF), D. Helfand, N. Zimmerman & J. Sarkissian (Columbia).

SCIENCE

2. DSAA

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

During the second quarter, the DSAA hosted the NRAO Postdoctoral Symposium, organized the NRAO Legacy Projects workshop, made an oral presenantation at the NASA Great Observatories meeting, and helped to organize the Chicago II meeting in August. A new policy for Target of Opportunity observations was developed for the GBT, and three new scientific referees were recruited. A new Scientific Staff Policy Manual was completed and distributed. A study of the NRAO staff demographics was presented to the AUI.

Personnel Items: DSAA was active this quarter in a number of areas. A promotion to Associate Astronomer was made to one member of the tenure track, and two staff members were promoted to the rank of Scientist. One adjunct appointment was renewed. The candidate search for a new member of the scientific staff continued from the last quarter. The process was successfully completed with the offer (and acceptance) of one person as an Associate Scientist. The tenure cases for two scientific staff were prepared and approved by the AUI board. One NRAO Postdoctoral position at the Green Bank site was offered and accepted.

A graduate internship was awarded to David Sevilla (University of Texas, El Paso) to work with Walter Brisken on radio-frequency interference and other unwanted features in the EVLA spectrum. Mr. Sevilla began work at the Array Operations Center in June.

A predoctoral Junior Fellowship was awarded to Andrew Michael (Rochester Institute of Technology) to work with Steven Myers on multi-scale deconvolution and image reconstruction, towards Mr. Michael's Ph.D. thesis, supervised by Prof. Stefi Baum at the Center for Imaging Science. Mr. Michael will begin work at the Array Operations Center in September.

A position as a Junior Engineering Associate was awarded to Diana Grijalva (New Mexico Tech) to work with Travis Newton as a co-op student. Ms. Grijalva began work at the Array Operations Center in May.

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3. TELESCOPE USAGE

NRAO telescopes were scheduled for research and maintenance during the second 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 hours of time lost, while losing one out of ten VLBA antennas for one hour counts as 0.1 hours of time lost.

Beginning in 2005, antennas being modified for the EVLA are accounted as downtime for observing.

Telescope Usage (hours)			
Activity	**VLA**	**VLBA**	**GBT**
Scheduled Observing	1619.54	1190.60	1716.00
Scheduled Maintenance and Equipment Changes	195.50	211.00	284.00
Scheduled Tests and Calibration	368.96	296.75	184.00
Time Lost	381.34	52.80	57.00
Actual Observing	1238.22	1137.80	1659.00

SCIENCE

4. GBT OBSERVING PROGRAMS

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

No	Observer(s)	Programs	Hours Observed
BB219	Bietenholz, M. F. (York) Bartel, N. (York) Rupen, M. P. (NRAO)	The Unusual Type Ib/c Supernova and GRB Candidate SN 2001em. 3.5 cm	13
BB223	Bartel, N. (York) Bietenholz, M. F. (York)	The expansion and deceleration of SNR 41.9+58 in M82. 11 cm	13
BF089	Forbrich, J. (MPIfR) Massi, M. (MPIfR) Ros, E. (MPIfR) Menten, K. M. (MPIfR)	Selected Protostars for the High Sensitivity Array. 3.5 cm	4
BK114	Kondratko, P.T. (CfA) Greenhill, L. J. (CfA) Moran, J. M. (CfA) Reid, M. J. (CfA)	Follow-up Imaging of Three NGC4258-like Water Megamasers Discovered with the GBT. 1.3 cm	16
BK127	Knudsen, K.K. (MPIA) Walter, F. (MPIA) Momjian, E. (Arecibo) Carilli, C. L. (NRAO) Yun, M. (Mass,)	Resolving the AGN and the starburst in an intensely starforming quasar. 21 cm	6
BM241	More, A. (MPIfR) Porcas, R. (MPIfR) Garrett, M. (JIVE) Nair, S. (Raman I)	A High Frequency Hsa Study Of The Gravitational Lens 2016+112. 3.5 cm	8
BU031	Ulvestad, J. (NRAO) Neff, S. G. (NASA/GSFC)	A Search for Young Supernovae in the Antennae Galaxies. 11 cm	6
GB058	Bartel, N. (York) Rupen, M. P. (NRAO) Bietenholz, M. F. (York) Beasley, T.A. (NRAO) Graham, D.A. (MPIfR) Altunin, V. (JPL) Venturi, T. (IRA, Bologna) Umana, G. (SRT, Cagliari) Cannon, W. (York) Conway, J. E. (Onsala Obs)	SN1993J: structural and spectral evolution at 6 and 18 cm. 6 cm	13
GBT01A-005	Turner, B. (NRAO) Langston, G. I. (NRAO)	A High-resolution Spectral Survey Of TMC-1 At Q-Band. 7 mm	4

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4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT04A-038	Mason, B.S. (NRAO) Readhead, A. C. S. (Caltech) Reeves Diaz, R. (Concepcion,) Bustos, R. (Concepcion,) Pearson, T. J. (Caltech) Myers, S. (NRAO) Shepherd, M. C. (Caltech)	GBT Observations of Radio Sources in CBI Intrinsic Anisotropy Fields. 9 mm	6
GBT04C-031	Kondratko, P.T. (CfA) Greenhill, L. J. (CfA) Moran, J. M. (CfA) Lovell, J.E.J. (CSIRO) Kuiper, T. B. H. (JPL) Jauncey, D. L. (CSIRO)	Monitoring of Five NGC4258-like Water Megamasers Discovered with the GBT and the DSN. 1.3 cm	19
GBT04C-043	Ransom, S. (NRAO) Freire, P. (Arecibo) Gupta, Y. (NCRA)	Timing the Eccentric Millisecond Pulsar Binary in Globular Cluster NGC 1851. 38 cm	7
GBT05B-028	Freire, P. (Arecibo) Ransom, S. (NRAO) Hessels, J. W. T. (McGill) Stairs, I. (UBC) Begin, S. (UBC)	A GBT S-Band Globular Cluster Survey: Phase A. 11 cm	1
GBT05B-032	Thorsett, S. (UC, Santa Cruz) Stairs, I. (UBC) Arzoumanian, Z. (NASA/GSFC)	Timing the millisecond pulsar B1620-26 with the GBT. 21 cm	1

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4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT05B-034	Stairs, I. (UBC) Camilo, F. (Columbia) Kramer, M. (JBO) Faulkner, A. (JBO) McLaughlin, M. (WVU) Lyne, A. G. (JBO) Hobbs, G. (ATNF) Manchester, D.R. N. (ATNF) Possenti, A. (Cagliari) D'Amico, N. (Cagliari) Burgay, M. (INAF, Italy) Ferdman, R. (UBC) Ramachandran, R. (UC, Berkeley) Backer, D. C. (UC, Berkeley) Demorest, P. (UC Berkeley) Nice, D. (Princeton)	Timing Binary and Millisecond Pulsars from the Parkes Multibeam Survey. 21 cm	21
GBT05B-042	Kramer, M. (JBO) Stairs, I. (UBC) Camilo, F. (Columbia) McLaughlin, M. (WVU) Lyne, A. G. (JBO) Manchester, D.R. N. (ATNF) Possenti, A. (Cagliari) D'Amico, N. (Cagliari) Burgay, M. (INAF, Italy) Freire, P. (Arecibo) Joshi, B. (TIFR) Ferdman, R. (UBC)	Timing and General Relativity in the Double Pulsar System. 21 cm, 38 cm	44
GBT05C-019	Robishaw, T. (UC, Berkeley) Heiles, C. E. (UC , Berkeley)	The Galactic Arachnid in the Ursa Major Loop. 21 cm	32
GBT05C-022	Braatz, J. A. (NRAO) Henkel, C. (MPIfR)	The Accretion Disks and Supermassive Black Holes in NGC 2273 and NGC 4051. 1.3 cm	8
GBT05C-023	Camilo, F. (Columbia) Ransom, S. (NRAO) Gaensler, B.M. (CfA) Slane, P.O. (CfA) Lorimer, D. (WVU) Manchester, D.R. N. (ATNF)	PSR J1833-1034, the Very Young Pulsar in the SNR G21.5-0.9. 38 cm	3

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4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT05C-026	Devlin, T. (Rutgers) Devlin, M.J. (Pennsylvania) Mason, B.S. (NRAO)	Polarization of 30 GHz emission from extra-galactic sources. 3.5 cm, 7 mm	3
GBT05C-033	Krco, M. (Cornell) Goldsmith, P. F. (JPL)	Structure and Formation of the Filamentary Cloud L204. 21 cm	4
GBT05C-037	Kanekar, N. (NRAO) Carilli, C. L. (NRAO) Langston, G. I. (NRAO) Stocke, J. T. (U Colorado) Menten, K. M. (MPIfR) Rocha, G. (Cambridge)	Measuring changes in fundamental constants with redshifted OH lines.	11
GBT05C-042	Ransom, S. (NRAO) Freire, P. (Arecibo) Hessels, J. W. T. (McGill) Begin, S. (UBC) Stairs, I. (UBC) Camilo, F. (Columbia) Kaspi, V. (McGill)	Timing the Binary and Millisecond Pulsars in NGC6440 and NGC6441. 11 cm	27
GBT05C-043	Kanekar, N. (NRAO) Carilli, C. L. (NRAO) Stocke, J. T. (Colorado)	A blind GBT survey for redshifted molecular absorption. 7 mm	7
GBT05C-046	Stairs, I. (UBC) Lorimer, D. (WVU)	Timing of a Relativistic Binary and other Pulsars from the Arecibo PALFA Survey. 21 cm	13
GBT05C-065	Braatz, J. A. (NRAO) Gugliucci, N. (UVA)	Measuring the Extragalactic Distance Scale: A Target of Opportunity. 1.3 cm	5
GBT05C-066	Remijan, A. (NRAO) Snyder, L. E. (Illinois) Friedel, D. (Illinois)	Comet 73/P Schwassmann-Wachmann: Molecular Complexity in Short Period Comets. 2 cm, 1.3 cm	10
GBT06A-003	Clemens, C. (North Carolina) Rosen, (North Carolina) Jacoby, B.A. (NRL)	Observational Tests for Non-radial Oscillations in Radio Pulsars. 21 cm	29
GBT06A-006	Vlemmings, W. (JBO) Diamond, P. J. (JBO)	The magnetic field in the circumnuclear disk of NGC 3079. 1.3 cm	31

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4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT06A-007	Possenti, A. (Cagliari) McLaughlin, M. (WVU) Burgay, M. (INAF, Italy) Turolla, R. (Padova) Popov, S. (SAI, Russia) Zane, S. (MSSL, UK)	Searching bursting radio emission from X-ray Dim Isolated Neutron Stars (XDINSs). 11 cm	63
GBT06A-009	Condon, J. J. (NRAO) Braatz, J. A. (NRAO) Lo, F.K. Y. (NRAO)	H_0 and Dark Energy. 1.3 cm	19
GBT06A-011	Blanton, M. (NYU) Geha, M. (Carnegie) West, A.A. (UC, Berkeley)	HI Content and Dynamics of Dwarf Disk Galaxies. 21 cm	81
GBT06A-014	Tarchi, A. (IRA, Bologna) Henkel, C. (MPIfR) Brunthaler, A. (MPIfR) Braatz, J. A. (NRAO)	H_2O vs Continuum in the Megamaser 3C403: Reverberation Mapping of the Nucleus. 1.3 cm	7
GBT06A-018	McMullin, J. (NRAO) Balser, D.S. (NRAO)	Isotopic Abundances in Planetary Nebulae. 7 mm	20
GBT06A-019	Osten, R.A. (UVA)	Wideband Dynamic Spectroscopy of Coherent Radio Bursts on Active M Dwarfs. 11 cm	21
GBT06A-020	Wiesenfeld, L. (UJF, France) Morris, M. R. (UCLA) Requena-Torres, M.A. (CSIC, Spain) Ceccarelli, C. (Grenoble, O) Faure, A. (UJF, France) Valiron, P. (UJF, France)	Cyanopolyynes in a low-mass protostar. 3.5 cm	5
GBT06A-022	Braatz, J. A. (NRAO) Gugliucci, N. (UVA) Frail, D. A. (NRAO) Markwardt, C. (NASA/GSFC) Tueller, J. (NASA/GSFC) Gehrels, N. (NASA/GSFC)	Water Vapor Megamasers in an X-Ray Selected Sample of AGNs. 1.3 cm	28
GBT06A-026	Kanekar, N. (NRAO) Ellison, S.E. (Victoria) York, B (Victoria)	A search for 21cm absorption towards MgII absorbers in the redshift desert. 50 cm	36

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4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT06A-027	Masters, K. (CfA) Huchra, J. (CfA) Macri, L. (NOAO) Jarrett, T.H. (IPAC) Crook, A. (MIT)	Mapping Matter in the Nearby Universe with 2MASS. 21 cm	86
GBT06A-028	Hewitt, J. (Northwestern) Yusef-Zadeh, F. (Northwestern)	Mapping Radio Recombination Line Emission Toward SNRs W28 and W44. 6 cm	2
GBT06A-030	Campbell, D. B. (Cornell) Campbell, B. (Smithsonian I) Carter, L. (Smithsonian I) Ghent, R. (Smithsonian I) Margot, J.L. (Cornell) Stacy, N. (DSTO)	Lunar surface studies via S-Band radar imagery and interferometry. 11 cm	4
GBT06A-032	Braatz, J. A. (NRAO) Lo, F.K. Y. (NRAO) Jewell, P. R. (NRAO)	A Search for the First SiO Megamaser. 7 mm	10
GBT06A-038	Troland, T. H. (Kentucky) Lockman, F. J. (NRAO) Robishaw, T. (UC, Berkeley) Benjamin, R.A. (UWW)	Magnetic Fields in the Galactic Halo via the HI Zeeman Effect. 21 cm	13
GBT06A-039	Camilo, F. (Columbia) Gaensler, B.M. (CfA) Lorimer, D. (WVU) Ransom, S. (NRAO)	Deep Searches of Three Pulsar Wind Nebulae. 11 cm	14
GBT06A-044	Darling, J. (Colorado) Stocke, J. T. (Colorado) Willett, K. (Colorado)	Intrinsic HI and OH Absorption in Compact Radio Sources at High Redshift. 38 cm	18
GBT06A-046	Langston, G. I. (NRAO) Turner, B. (NRAO)	A search for the Largest Interstellar Molecule, $HC_{13}N$. 2 cm	95
GBT06A-047	Requena-Torres, M.A. (CSIC, Spain) Martin-Pintado, J. (CSIC, Spain) Martin, S. (IRAM, Spain) Morris, M. R. (UCLA) Rodriguez-Franco, A. (CSIC, Spain)	Complex Molecules in the Galactic Center molecular clouds. 1.3 cm	40

SCIENCE

4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT06A-049	Readhead, A. C. S. (Caltech) Weintraub, L. (Caltech) Mason, B.S. (NRAO) Pearson, T. J. (Caltech) Shepherd, M. C. (Caltech)	Definitive Detection of Excess Arcminute Scale CMB Anisotropies. 9 mm	55
GBT06A-050	Begin, S. (UBC) Freire, P. (Arecibo) Ransom, S. (NRAO) Stairs, I. (UBC) Hessels, J. W. T. (McGill) Kaspi, V. (McGill)	Timing of the Binary and Millisecond Pulsars in M28, NGC6624 and NGC6522. 11 cm	7
GBT06A-053	Ransom, S. (NRAO) Hessels, J. W. T. (McGill) Stairs, I. (UBC) Freire, P. (Arecibo) Kaspi, V. (McGill) Camilo, F. (Columbia)	Continued Timing of the Binary and Millisecond Pulsars in Terzan 5. 11 cm	12
GBT06A-054	Demorest, P. (UC, Berkeley) Backer, D. C. (UC ,Berkeley) Ferdman, R. (UBC) Stairs, I. (UBC) Nice, D. (Princeton) Jacoby, B.A. (NRL) Bailes, M. (Swiburne) Ord, S. (Sydney)	Long-term Precision Timing of Millisecond Pulsars. 21 cm	49
GBT06A-056	Kondratko, P.T. (CfA) Greenhill, L. J. (CfA) Moran, J. M. (CfA)	Are there Unrecognized NGC4258-like Systems Among Known Water Masers in AGN? 1.3 cm	32
GBT06A-059	Kanekar, N. (NRAO) Shirley, Y.L. (Arizona)	Using CCH lines to measure changes in fundamental constants. 7 mm	3
GBT06A-061	Zwaan, M.A. (ESO) Peroux, C. (ESO) Liske, J. (ESO) Murphy, M. T. (Cambridge) Bouche, N. (MPIfEP) Curran, S. (UNSW)	HI 21-cm absorption in MgII and CaII absorbers. 38 cm	39

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4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT06A-063	Zwaan, M.A. (ESO) Peroux, C. (ESO) Liske, J. (ESO) Murphy, M. T. (Cambridge) Bouche, N. (MPIfEP) Curran, S. (UNSW)	Where are the molecular absorption lines? 21 cm	53
GBT06A-065	Friesen, R. (Victoria) Di Francesco, J. (NRC, Canada) Johnstone, D. (NRC, Canada) Shirley, Y.L. (Arizona)	Probing the initial conditions of star formation in Ophiuchus. 1.3 cm	27
GBT06A-066	Nidever, D. (UVA) Majewski, S.R. (UVA) Burton, W. B. (NRAO)	HI Mapping of the Extended Magellanic Stream. 21 cm	17
GBT06A-067	Lovell, A. (Agnes Scott College) Howell, E. (Arecibo) Butler, B. (NRAO) Schloerb, F. P. (Mass)	Observations of 73P/Schwassmann-Wachmann-3 at Close Approach to Earth. 21 cm	48
GBT06A-070	Camilo, F. (Columbia) Ransom, S. (NRAO) Halpern, J. P. (Columbia) Helfand, D. J. (Columbia)	A new radio transient 38 cm, 11 cm, 6 cm, 2 cm, 3.5 cm	20
GBT06A-071	Camilo, F. (Columbia) Minter, A. (NRAO) Ransom, S. (NRAO) Zimmerman, N. (Columbia) Helfand, D. J. (Columbia) Halpern, J. P. (Columbia) Reynolds, J. E. (ATNF)	Constraining the distance to the magnetar XTE J1810-197 via HI absorption. 21 cm	3
GBT06A-072	Kaspi, V. (McGill) Champion, (McGill) Hessels, J. W. T. (McGill)	ToO GBT Observations of AXP 4U 0142+61. 11 cm	2
GBT06B-019	Minter, A. (NRAO)	Obtaining A Complete Sample Of Pulsar OH Absorption With The GBT. 21 cm	41

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4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT06B-020	O'Neil, K. (NRAO) Davies, J. (Cardiff) Auld, R. (Cardiff) Martin, B. (ESO) Boselli, A. (MPO, France) Bothun, G. D. (Oregon) Brosch, N. (WO, Israel) Brinks, E. (Hertfordshire) Cantinells, (NAIC) Disney, M. J. (Cardiff) de Blok, E. (Cardiff) Gavazzi, G. (Milano) Giovanelli, R. (Cornell) Haynes, M. P. (Cornell) Henning, T. (UNM) Hoffman, G. L. (Lafayette College) Irwin, J. (Queens) Karachentsev, I.D. (SAO, Russia) Kilborn, V.A. (Swiburne) Koribalski, B. (ATNF) Linder, S.M. (Cardiff) Minchin, R.F. (NAIC) Momjian, E. (Arecibo) Putman, M. (Michigan) Rosenberg, J.L. (CfA) Sabatini, (OAR, Italy) Schneider, S. E. (Mass) Spekkens, K. (Rutgers) van Driel, W. (Paris O, France)	HI in Galaxies and Environments. 21 cm	10
GBT06B-021	Masters, K. (CfA) Huchra, J. (CfA) Crook, A. (MIT) Macri, L. (NOAO) Jarrett, T.H. (IPAC)	Mapping Matter in the Nearby Universe with 2MASS. 21 cm	36

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4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT06B-022	Zwaan, M.A. (ESO) Peroux, C. (ESO) Liske, J. (ESO) Murphy, M. T. (Cambridge) Bouche, N. (MPIfEP) Curran, S. (UNSW)	A search for molecules in CaII absorbers	27
GBT06B-023	Mangum, J. G. (NRAO) Menten, K. M. (MPIfR) Henkel, C. (MPIfR) Darling, J. (Colorado)	Formaldehyde Densitometry of External Galaxies. 2 cm, 6 cm	62
GBT06B-028	Stairs, I. (UBC) Thorsett, S. (UC, Santa Cruz) Arzoumanian, Z. (NASA/GSFC)	Timing the Planet Pulsar in M4. 11 cm	1
GBT06B-029	McSwain, G. (Yale) Ransom, S. (NRAO) Roberts, M. (Eureka Sci) Boyajian, T. (Georgia State) Grundstrom, E. (Georgia State) Gies, D. (Georgia State)	Pulsars in Quiet Massive X-ray Binary Candidates. 11 cm, 38 cm	14
GBT06B-030	Martin, P.G. (U of T) Boothroyd, A. (U of T) Viero, M. (U of T) Miville-Deschenes, M. (IAS, France) Lockman, F. J. (NRAO)	Characterizing Dust Evolution in Intermediate Velocity Clouds. 21 cm	24
GBT06B-031	Muno, M. P. (UCLA) Ransom, S. (NRAO) Figer, D. (STScI)	Searching for Pulsars in Massive Young Star Clusters. 38 cm	11
GBT06B-032	Begin, S. (UBC) Freire, P. (Arecibo) Ransom, S. (NRAO) Stairs, I. (UBC) Hessels, J. W. T. (McGill) Kaspi, V. (McGill) Camilo, F. (Columbia)	Timing of the Binary and Millisecond Pulsars in M28. 11 cm	4

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4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT06B-033	Hessels, J. W. T. (McGill) Ransom, S. (NRAO) Kaspi, V. (McGill) Champion, (McGill) Roberts, M. (Eureka Sci)	Completing a 350-MHz Survey of the Galactic Plane for Pulsars and Transients. 38 cm	8
GBT06B-035	Kent, B. (Cornell) Giovanelli, R. (Cornell) Haynes, M. P. (Cornell) Lockman, F. J. (NRAO)	ALFALFA HI Clouds: Milky Way HVCs or Virgo Cluster Harassment Remnants? 21 cm	11
GBT06B-040	Kanekar, N. (NRAO) Frail, D. A. (NRAO) Macquart, J.P. (NRAO) van Straten, W. (NFRA)	A Targeted High Frequency Search for Pulsars at the Galactic Center. 2 cm	17
GBT06B-044	Ferdman, R. (UBC) Stairs, I. (UBC) Backer, D. C. (UC, Berkeley) Burgay, M. (INAF, Italy) Camilo, F. (Columbia) D'Amico, N. (Cagliari) Demorest, P. (UC at Berkeley) Faulkner, A. (JBO) Hobbs, G. (ATNF) Kramer, M. (JBO) Lorimer, D. (WVU) Lyne, A. G. (JBO) Manchester, D.R. N. (ATNF) McLaughlin, M. (WVU) Nice, D. (Princeton) Possenti, A. (Cagliari)	Timing Binary and Millisecond Pulsars from the Parkes Multibeam Survey. 21 cm	28
GBT06B-045	Hewitt, J. (Northwestern) Yusef-Zadeh, F. (Northwestern)	A Continued Search for Supernova Remnant Masers. 21 cm	20
GBT06B-049	Margot, J.L. (Cornell) Peale, S. (UC at Santa Barbara) Jurgens, R. (JPL) Slade, M. (JPL)	High-precision measurements of the spin of Mercury. 3.5 cm	2

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4. GBT OBSERVING PROGRAMS

No	Observer(s)	Programs	Hours Observed
GBT06B-050	Heroux, A.J. (NRAO) Martin, E. (NRAO) Minter, A. (NRAO) Thomas, (NRAO) Metha, K. (NRAO)	Green Bank REU Student GBT Exploratory Time. 1.3 cm, 21 cm	11
GBT06B-051	Mangum, J. G. (NRAO)	NRAO CV Summer Student Observing Project. 2 cm, 21 cm	12
GD021	Diamond, P. J. (JBO) Lonsdale, C. J. (Haystack) Thrall, H. (Manchester) Lonsdale, C. J. (IPAC) Smith, H. E. (UC , San Diego) Conway, J. E. (Onsala Obs) Parra, R. (Onsala Obs)	Monitoring the evolution of the compact emission of Arp 220. 21 cm	14
GM062	Orienti, M. (IRA, Bologna) Morganti, R. (NFRA) Dallacasa, D. (IRA, Bologna) Oosterloo, T. (NFRA)	What causes the very broad HI absorption in radio galaxies? 21 cm	6
GV018	Kanekar, N. (NRAO) Vermeulen, R. (NFRA) Briggs, F. H. (ANU)	The kinematics of a gravitational lens at z = 0.7645. 38 cm	9

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5. VLA OBSERVING PROGRAMS

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

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

No.	Observer(s)	Programs	Hours Observed
AA301	Argo, M. (Manchester) Beswick, R. (Manchester) Fenech, D. (Manchester) Muxlow, T. (Manchester) Pedlar, A. (Manchester) Wills, K. (Sheffield)	Continued monitoring of radio supernovae and SNR in nearby starbursts. 2, 3.6, 6, 20 cm	0.83
AA303	Axon, D. (Rochester) Capetti, A. (Torino) Balmaverede, B. (Torino) Batcheldor, D. (Rochester) Merritt, D. (Rochester)	Deep study of nucleated dwarf ellipticals in Virgo Cluster. 3.6 cm	27.46
AA304	Araya, E. (NMIMT) Hofner, P. (NMIMT) Goss, W.M. (NRAO) Linz, H. (MPIA) Kurtz, S. (MEXICO/UNAM) Olmi, L. (CNR)	Formaldehyde 6cm maser in G23.71-0.20. 6 cm	4.42
AA305	Araya, E. (NMIMT) Hofner, P. (NMIMT) Goss, W.M. (NRAO) Linz, H. (MPIA) Kurtz, S. (MEXICO/UNAM) Olmi, L. (CNR)	Formaldehyde 6cm masers from Arecibo and GBT surveys. 6 cm	13.02
AB1187	Brogan, C. (Hawaii) Kassim, N. (NRL) Lazio, T.J.W. (NRL) Nord, M. (NRL)	Galactic center mosaic at 330 MHz. 90 cm	23.99
AB1192	Birkinshaw, M. (Bristol) Worrall, D. (Bristol) Schwartz, D. (CfA) Marshall, H. (MIT)	Deep 90 cm imaging of unusual X-ray emission in PKS 1055+201. 90 cm	4.82

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AB1196	Beltran, M. (Barcelona) Cesaroni, R. (Arcetri) Codella, C. (CNR) Furuya, R. (Caltech) Olmi, K. (CNR) Testi, L. (Arcetri)	Continuum source in massive disk G24.78+0.08. 0.7, 1.3 cm	7.89
AB1198	Brunthaler, A. (MPIfR) deBlock, E. (Mt. Stromlo) Reid, M. (CfA) Henkel, C. (MPIfR) Falcke, H. (ASTRON)	Water maser survey of NGC 6822. 1.3 cm	3.67
AB1204	Bietenholz, M. (York) Bartel, N. (York) Rupen, M. (NRAO)	Spectral evolution on young pulsar nebula/black hole in SN 1986J. 0.7, 1.3 cm	5.66
AB1207	Brunthaler, A. (MPIfR) Menten, K. (MPIfR) Reid, M. (CfA) Marshall, H. (MIT)	Calibrator search near methanol masers. 3.6, 6 cm	6.95
AB1210	Blomme, R. (OMA) DeBecker, M. (Liege) Rauw, G. (Liege) Runacres, M. (Brussel) VanLoo, S. (Leeds)	Colliding winds of the O+O star binary Cyg OB2. 3.6, 6 cm	0.75
AB1212	Blake, C. (British Columbia) Moore, J. (Queensland) Pimbblet, K. (Queensland) Drinkwater, M. (Queensland)	Continuum imaging toward local super cluster filaments. 20 cm	4.13
AC749	Colina, L. (IFCA) Alberdi, A. (IAA, Spain) Torrelles, J. (Barcelona) Panagia, N. (STScI) Wilson, A. (Maryland)	Search for RSNe in highly luminous infrared galaxies. 3.6 cm	4.65
AC750	Clarke, T. (NRL) Lane, W. (NRL) Sarazin, C. (Virginia) Kassim, N. (NRL)	FRIs in high- and low-density environments. 90, 400 cm	4.82

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AC803	Carilli, C. (NRAO) Beelen, A. (IAP) Bertoldi, F. (Bonn) Cox, P. (IRAM) Fan, X. (ASU) Menten, K. (MPIfR) Omont, A. (IAP) Strauss, M. (Princeton) Walter, F. (MPIA, Bonn)	VLA Obssevations of $z \sim 6$ SDSS QSOs. 20 cm	7.02
AC805	Croston, J. (Hertfordshire) Hardcastle, M. (Hertfordshire) Kraft, R. (CfA)	Structure and spectral indices of PKS 2354 in core of Abell 4059. 20 cm	1.22
AC806	Clarke, T. (NRL) Sarazin, C. (Virginia) Reiprich, T.(Bonn)	Structure and spectrum of radio relic in Abell 4038. 90, 400 cm	4.77
AC807	Capetti, A. (Torino) Balmaverde, B. (Torino) Axon, D.J. (Rochester)	Continuum survey of nearby early-type galaxies. 6 cm	3.61
AC809	Clarke, T. (NRL) Sarazin, C. (Virginia) Reiprich, T. (Bonn)	Structure and spectrum of radio relic in Abell 4038. 90, 400 cm	16.71
AC810	Curiel, S. (MEXICO/UNAM) Canto, J. (MEXICO/UNAM) Ho, P. (CfA) Rodriguez, L. (MEXICO/UNAM) Torrelles, J. (IEEC) Patel, N. (CfA)	Monitoring the high-mass Cepheus A/HW2 source. 0.7 cm	8.06
AC811	Choi, M. (KAO-TRAO)	Water maser at protostellar jet-core impact point. 1.3 cm	1.21
AC812	Castangia, P. (Oss. Di Cagliari) Tarchi, A. (IRA) Henkel, C. (MPIfR) Menten, K. (MPIfR)	Water maser and continuum in merger galaxy NGC 520. 1.3 cm	2.81
AC817	Chandler, C. (NRAO) Greenhill, L. (CfA) Reid, M. (CfA) Humphreys, L. (CfA) Matthews, L. (NRAO)	Kinematics and polarimetry of SiO masers in source I in Irion. 0.7 cm	29.33

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AC819	Claussen, M. Healy, K. (ASU) Bond, H. (STScI) Starrfield, S. (ASU) Woodward, C. (Minnesota) Gehrz, R. (Minnesota) Evans, A. (Keele) Rushton, M. (Keele)	Monitoring the SiO masers in V838 Monocerotis. 0.7, 1.3 cm	4.06
AC821	Clarke, T. (NRL) Reynolds, C. (Maryland)	Structure and spectral indices of PKS 2354 in core of Abell 4059. 20 cm	7.09
AC825	Chomiuk, L. (Wisconsin) Wilcots, E. (Wisconsin) Doane, N. (Wisconsin) Sanders, W. (Wisconsin) Zweibel, E. (Wisconsin)	Imaging X-ray super bubbles in nearby spiral galaxies. 20 cm	6.50
AC827	Curiel, S. (MEXICO/UNAM) Girart, J.M. (Barcelona)	Structure of protostellar systems in L1448N IRS3. 0.7, 1.3 cm	5.61
AD521	Dulwich, F. (Bristol) Birkinshaw, M. (Bristol) Padgett, C. (UMBC) Perlman, E. (UMBC) Worrall, D. (Bristol)	Mapping the magnetic field in jet of 3C15. 2 cm	4.81
AD525	Diamond-Stanic, A. (ASU) Carilli, C. (NRAO) Fan, X. (ASU) Anderson, S. (Caltech) Brandt, W. (Penn State) Kim, J. (ASU) Schneider, D. (Penn State) Strauss, M. (Princeton)	Structure of high redshift quasars without emission lines. 6, 20 cm	5.69
AD527	Dey, A. (NOAO) Soifer, B. (Caltech) Weedman, D. (Cornell) Higdon, J. (Cornell) Jannuzi, B. (NOAO) Brand, K. (NOAO)	Large Ly alpha nebula at $z = 2.656$. 6, 20 cm	16.01
AD529	Dupke, R. (Michigan) Clarke, T. (NRL)	Are cold fronts generated by ICM Buoyant bubbles? 90 cm	7.32

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AD530	Delaney, T. (CfA) Kassim, N.E. (NRL) Gaensler, B. (CfA)	Spectral index imaging of SN 1006. 90, 400 cm	6.48
AE153	Eilek, J. (NMIMT)	Imaging of cooling-core radio sources. 20, 90 cm	33.13
AE156	Eyres, S. (Lancashire) Bode, M. (JMU) O'Brien, T. (Manchester) Evans, N. (Texas) Davis, R. (Manchester) Worters, H. (Lancashire) Porcas, R. (MPIfR) Uytterhoeven, K. (Lancashire)	ToO Observations of RS Oph. 1.3, 3.6, 6, 20 cm	6.21
AE157	Eyres, S. (Lancashire) Bode, M. (JMU) O'Brien, T. (Jodrell Bank) Evans, N. (Texas) Davis, R. (Jodrell Bank) Worters, H. (Lancashire) Porcas, R. (MPIfR) Rushton, M. (Keele)	ToO Observations of RS Oph. 1.3, 3.6, 6, 20 cm	3.25
AF431	Frail, D. (NRAO) Cameron, P. (Caltech) Kulkarni, S. (Caltech)	Triggered search for coherent emission from GRBs. 90, 400 cm	1.10
AF433	Franco-Hernandez, R. (CfA) Moran, J. (CfA) Rodriguez, L. (MEXICO/UNAM) Lizano, S. (MEXICO/UNAM) Avolos, M. (MEXICO/UNAM)	Structure of hyper-compact HII regions. 0.7 cm	3.33
AF434	Franco-Hernandez, R. (CfA)	Time variability in ultra-compact HII region NGC 7538 IRS1. 2 cm	3.09
AF438	Frail, D. (NRAO)	Shell-type SNRs with evidence for TeV emission. 20 cm	5.64

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AF439	Figer, D. (STScI) Law, C. (Northwestern) Kudritzki, R. (Hawaii) Najarro, P. (CSIC) MacKenty, J. (STScI) Robberto, M. (STScI) Muno, M. (UC, Los Angeles) Herrero, A. (IAC)	Structure and spectra of two clusters of red supergiants. 6, 20 cm	5.30
AF440	Fish, V. (NRAO) Brisken, W. (NRAO) Sjouwerman, L. (NRAO)	Where did it go? 20 cm	0.10
AF441	Fish, V. (NRAO) Sjouwerman, L. (NRAO)	Excited OH in OH/IR stars. 6 cm	4.10
AG697	Gross, C. (NRL) Brogan, C. (Hawaii) Clarke, T. (NRL) Dickel, J. (Illinois) Kassim, N. (NRL) Weiler, K. (NRL)	Low-frequency imaging of the SNR IC443. 90, 400 cm	9.49
AG710	Giroletti, M. (Bologna) Giovannini, G. (Bologna) Taylor, G. (UNM)	High-resolution observations of low-power compact radio galaxies. 1.3 cm	3.24
AG711	Greaves, J. (St. Andres) Richards, A.M.S. (Manchester)	Structure of HL Tau at 5 AU resolution. 1.3 cm	8.35
AG715	Gaensler, B. (CfA) Gelfand, J. (CfA) Taylor, G. (UNM) Kouvelioutou, C. (NASA) Eichler, D. (Ben Gurion) Lyubarsky, Y. (Ben Gurion) Granot, J. (KIPAC) Ramirez-Ruiz, E. (IAS) Wijers, R. (Amsterdam) Fender, R.P. (Southampton) Garrett, M. (JIVE)	Imaging and monitoring of afterglow of SGR 1806-20. 3.6 cm	10.26

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AG716	Giantucci, S. (INAF) Venturi, T. (INAF) Brunetti, G. (NAF) Cassano, R. (Bologna) Dallacasa, D. (Bologna) Bardelli, S. (INAF)	Radio galaxy in cluster A521. 3.6, 6 cm	5.69
AG718	Garay, G. (Chile) Brooks, K. (ATNF) Franco-Hernandez, R. (CfA) Moran, J. (CfA) Rodriguez, L. (MEXICO/UNAM)	Proper motions in radio lobes of massive protostar IRAS 16547-4247. 3.5 cm	3.26
AG722	Galvan-Madrid, R. (MEXICO/UNAM)	Rare maser species. 1.3 cm	1.66
AG726	Gugliucci, N. (Virginia) Braatz, J. (NRAO)	Cals and maser position for UGC 3789. 1.3 cm	1.62
AG727	Giovannini, G. (Bologna) Feretti, L. (Bologna) Giroletti, M. (Bologna) Taylor, G. (UNM)	Multi-frequency monitoring of the superluminal giant radio galaxy 1144+35. 2, 6, 20 cm	1.74
AH885	Harris, D.E. (CfA)	Monitoring knot HST-1 in M87 jet. 1.3, 2, 3.6 cm	6.37
AH893	Hardcastle, M. (Hertfordshire) Croston, J. (Hertfordshire) Kassim, N. (NRL) Perley, R. (NRAO)	Low frequency observations of 3C 353. 90, 400 cm	6.90
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 the GC. 90 cm	10.58
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	2.11

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AH902	Hofstadter, M. (JPL) Butler, B. (NRAO) Gurwell, M. (CfA) Orton, G. (JPL) Hammel, H. (SSI)	Imaging the atmospheres of Uranus and Neptune. 1.3, 2, 6 cm	25.76
AH908	Hallinan, G. (NUI) Golden, A. (Galway) Doyle, J. (Armagh) Antonova, A. (Armagh) Bourke, S. (NUI) Brisken, W. (NRAO)	Continuum monitoring of an M9 dwarf. 3.6, 6 cm	18.79
AH910	Hamidouche, M. (Illinois) Looney, L. (Illinois) Wang, S. (Illinois)	Resolving and probing circumstellar structures of Herbig AeBe stars. 0.7, 1.3, 3.6 cm	8.01
AH912	Haan, S. (MIA) Schinnerer, E. (MIA) Mundell, C. (JMU) Garcia-Burillo, S. (Obs. National) Combes, F. (Paris Obs)	HI imaging of selected NUGA galaxies. 20 cm	16.09
AH913	Helfand, D. (Columbia) Becker, R. (UC, Davis) White, R. (STScI)	MAGPIS: A multi-array galactic plane imaging survey. 20 cm	6.55
AH917	Helfand, D. (Columbia)	Monitoring the remarkable transient AXP XTE J1810-197. 3.6, 6, 20 cm	3.62
AJ325	Johnson, K. (Virginia) Hunt, L.K. (Arcetri) Hibbard, J. (NRAO) Thuan, T.X. (Virginia)	Survey for super star clusters in low-metallicity galaxies. 1.3, 3.6, 6 cm	18.54
AJ326	Jacoby, B. (NRC) Lazio, T.J.W. (NRL)	Birthplace of PSR B1834-06? 20 cm	1.56
AJ328	Johnson, K. (Virginia) Hunt, L. (Arcetri) Ulvestad, J. S. (NRAO)	Supernova candidate in ultra-low metallicity galaxy SBS0335-052. 3.6, 20 cm	2.29

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AK583	Kulkarni, S. (Caltech) Soderberg, A. (Caltech) Cenko, S. (Caltech) Frail, D. (NRAO) Harrison, F.A. (Caltech) Fox, D. (Caltech) Gal-Yam, A. (Caltech) Moon, D-S. (Caltech) Cameron, B. (Caltech)	Gamma-ray bursts, X-ray flashes, and core collapse SNe. 0.7, 13. Cm	12.40
AK626	Karovska, M. (CfA) Matthews, L. (NRAO)	Multi-frequency continuum monitoring of Mira A & B. 0.7, 1.3 cm	8.0
AK627	Khan, S. (CfA) Ashby, M. (CfA) Benford, D. (NASA) Carilli, C. (NRAO) Chanial, P. (NRC) Shafer, R. (NASA) Staguhn, J. (Cologne) Willner, S. (CfA)	Deep observation of first 350-micron selected galaxy. 20 cm	7.64
AK634	Kulkarni, S. (Caltech) Frail, D. (NRAO) Fox, D. (Penn State)	Long and short of radio afterglows in the Swift Era. 0.7, 20 cm	11.46
AK635	Kedziora-Chudczer, L. (ATNF)	Extreme scintillator PKS 0405-385. 3.6, 6 cm	6.22
AK636	Koerding, E. (Southampton) Rodriguez, L. (MEXICO/UNAM) Mirabel, F. (ESO)	Jet-driven water masers in GRS 1915+105. 1.3 cm	0.56
AL664	Landt, H. (CfA) Bignall, H. (JIVE) Padovani, P. (ESO) Perlman, E. (Maryland)	Imaging a faint sample of BL Lacertae objects. 20 cm	8.44
AL666	Leipski, C. (Bochum) Bennert, N. (UC, Riverside) Falcke, H. (ASTRON)	Polarimetry of "figure 8" jet of ESO 428-G14. 3.6 cm	4.10

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AL670	Lazio, T.J.W. (NRL) Kassim, N. (NRL) Cohen, A. (NRL) Lane, W. (NRL) Clarke, T. (NRL)	Imaging FRII radio galaxies at low frequencies. 90, 400 cm	11.42
AM831	Monnier, J. (Michigan) Greenhill, L. (CfA) Tuthill, P. (Sydney) Danchi, W. (NASA)	Monitoring the colliding-wind binary WR 112. 3.6 cm	1.28
AM845	Menten, K. (MPIfR) Reid, M. (CfA) Claussen, M. (NRAO) Sahai, R. (JPL)	Imaging carbon star IRC+10216. 0.7, 1.3 cm	5.83
AM855	Myers, S. (NRAO) Boyce, E. (MIT) Winn, J. (CfA)	Search for asymmetric gravitational lenses from CLASS. 1.3, 3.6, 6 cm	1.28
AM857	Morrison, G. (Hawaii) 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. 20 cm	63.67
AM858	Miller-Jones, J. (Amsterdam) Fender, R. (Southampton) Rupen, M. (NRAO)	Triggered monitoring of GRS 1915+105. 0.7, 1.3 cm	9.43
AM859	Martin-Pintado, J. (CSIC) Chandler, C. (NRAO) Thum, C. (IRAM)	Kinematics of disk around massive star in MWC349. 1.3 cm	11.95
AM865	McNamara, B. (NMSU) Rupen, M. (NRAO) Harrison, T. (NMSU)	Coordinated VLA/RXTE/APO/Keck look at LMXB GX 17+2. 0.7, 1.3, 2, 3.6, 6, 20 cm	0.96

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AM868	Miller, N. (Johns Hopkins) Hornschemeier, A. (STScI) Mobasher, B. (STScI)	Deep continuum imaging of two regions in Coma cluster. 20 cm	23.33
AN127	Nakanishi, K. (Nobeyama) Okumura, S. (Nobeyama) Kawabe, R. (Nobeyama) Kohno, K. (Tokyo) Kuno, N. (Nobeyama) Sato, N. (NAOJ)	SED monitoring of luminous galaxy NGC6240. 1.3, 2 cm	2.43
AO198	Ofek, E. (Tel Aviv) Frail, D. (NRAO) Gal-Yam, A. (Caltech)	Survey for radio-selected supernovae. 3.6, 20 cm	8.99
AO199	Olsson, E. (Onsala) Beswick, R. (Jodrell Bank) Aalto, S. (Onsala) Magnusson, J. (Onsala) Pedlar, A. (Jodrell Bank)	HI absorption study of LINERs NGC 5218+ NGC 1614. 20 cm	6.41
AO201	Owen, F. (NRAO) Morrison, G. (Hawaii) Lonsdale, C.J. (Caltech) Eilek, J. (NMIMT) Smith, G. (UC, San Diego) Polletta, M. (UC, San Diego)	Imaging SWIRE Deep Field. 90 cm	10.19
AO205	Osten, R. (Maryland) Hawley, S. (Washington) Bastian, T. (NRAO) Reid, I.N. (STScI)	Spectrum of radio emission from brown dwarfs. 3.6, 6, 20 cm	8.73
AP452	Perley, R. (NRAO) Condon, J. J. (NRAO) Cotton, W.D. (NRAO) Lane, W. (NRL) Cohen, A. (NRL) Kassim, N. (NRL) Lazio, T. (NRL) Erickson, W (Maryland)	VLA low-frequency sky survey (VLSS). 400 cm	35.13
AP500	Pihlstrom, Y. (UNM)	Monitoring galactic center 1720 MHz OH masers. 20 cm	6.28

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AP502	Paladino, R. (Oss. Di Cagliari) Murgia, M. (Bologna)	Continuum CO correlation for NGC 3627 at hundred-parsec resolution. 20 cm	9.78
AP503	Pihlstrom, Y. (UNM) Sjouwerman, L. (NRAO)	Extragalactic 1720 MHz OH megamasers. 20 cm	9.51
AP504	Paladino, R. (Oss. Di Cagliari) Murgia, M. (Bologna) Orru, E. (Oss. Di Cagliari)	Spectral-index image of spiral galaxy NGC 4826. 90 cm	5.59
AP509	Perley, R. (NRAO) Condon, J. J. (NRAO) Cotton, W.D. (NRAO) Lane, W. (NRL) Cohen, A. (NRL) Kassim, N. (NRL) Lazio, T. (NRL) Erickson, W (Maryland)	Low-frequency Sky Survey wrap-up. 400 cm	19.94
AP510	Paredes, J. (Barcelona) Marti, J. (Jaen) Chandra, I. (NCRA) Bosch-Ramon, V. (Barcelona)	TeV J2032+4130 in Cygnus. 3.6 cm	1.70
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 cm	18.74
AR587	Romani, R. (Stanford) Healey, S. (Stanford) Taylor, G. (UNM) Ulvestad, J. S. (NRAO) Michelson, P. (Stanford) Sadler, E. (Sydney)	Survey for GLAST blazar candidates. 3.6 cm	5.90
AR593	Rodriguez, L. (MEXICO/UNAM) Gomez, L. (MEXICO/UNAM) Loinard, L. (MEXICO/UNAM) Lizano, S. (MEXICO/UNAM)	Proper motions of compact continuum sources in Orion. 3.6 cm	7.76
AR595	Reid, M. (CfA) Menten, K. (MPIfR)	Continuum and SiO study of VY Cma. 0.7 cm	5.56
AR596	Robberto, M. (STScI) Kamp, I. (STScI) Keto, E. (CfA)	Imaging Orion Proplyds. 20 cm	3.61

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AR603	Rupen, M. (NRAO)	Monitoring of and triggered response to X-ray transients. 0.7, 1.3 cm	67.63
AR604	Riechers, D. (MPIA) Walter, F. (MPIA) Carilli, C. (NRAO) Bertoldi, F. (Bonn) Weiss, A. (MPIfR)	Imaging the molecular Einstein ring at z = 4.12. 0.7 cm	37.99
AS831	Shepherd, D. (NRAO) Testi, L. (Arcetri) DePree, C. (Agnes Scott) Scoles, S. (Agnes Scott)	Massive outflow sources observed with Spitzer. 3.6 cm	5.90
AS846	Soderberg, A. (Caltech) Kulkarni, S. (Caltech) Frail, D. (NRAO) Chevalier, R. (Virginia)	Enigmatic Type Ibc Supernovae and their mysterious engines. 0.7, 1.3, 2, 3.5, 6, 20 cm	0.83
AS860	Schmitt, H. (NRL) Rosa Gonzalez, D. (INAOE) Terlevich, R. (Cambridge) Terlevich, E. (INAOE)	Search for young star clusters in nearby starbursts. 3.6, 6, 20 cm	8.01
AS865	Stalder, B. (CfA) Chambers, K. (Hawaii)	Imaging sources near bright natural guide stars. 3.6 cm	1.22
AS873	Stocke, J. (Colorado) Hart, Q. (Colorado)	Structure of AGN in ten clusters of nearby galaxies. 20 cm	3.14
AS876	Sokoloski, J. (CfA) Rupen, M. (NRAO) Mioduszewski, A. (NRAO)	Structure of RS Oph. 0.7, 1.3, 3.6 cm	4.88
AS877	Soderberg, A. (Caltech)	Over luminous Type Ic at 220 Mpc. 3.6 cm	0.40
AS878	Sjouwerman, L. (NRAO) Brunthaler, A. (MPIfR)	Possible OH masers in M31. 18 cm	1.65
AT316	Thuan, T. (Virginia) Izotov, Y. (Main Astron. Obs.) Hunt, L. (Arcetri) Hibbard, J. (NRAO)	Continuum observations of metal-deficient blue compact dwarfs. 20 cm	3.61

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AT317	Torrelles, J. (IEEC) Dent, W. (ROE) Osorio, M. (IAA, Spain) Calvet, N. (Michigan) Anglada, G. (IAA, Spain)	Circumstellar disc around Herbig AeBe star HD 1691242. 0.7 cm	2.01
AT318	Taylor, G. (UNM) Fabian, A. (Cambridge) Allen, S. (Stanford) Gentile, G. (SISSA)	Search for emission in high-luminosity clusters. 20, 90 cm	8.04
AT319	Tarchi, A. (IRA) Brunthaler, A. (MPIfR) Henkel, C. (MPIfR) Braatz, J. (NRAO)	Continuum monitoring of megamaser galaxy 3C 403. 1.3 cm	9.34
AT329	Tsai, C-W. (UC, Las Angeles) Turner, J. (UC, Los Angeles) Meier, D. (NRAO)	Continuum survey for HII regions in NGC 2403. 3.6, 6 cm	7.30
AT330	Tripp, T. (Massachusetts) Yun, M. (Massachusetts)	Rare opportunity to study 21cm absorption and emission in a nearby galaxy. 20 cm	1.54
AU106	Urrutia, T. (UC, Davis) Becker, R. (UC, Davis) Gregg, M. (UC, Davis)	Observations of dust-obscured quasars. 6 cm	
AU110	Umana, G. (INAF) Buemi, C. (INAF) Leto, P. (INAF) Trigilio, C. (INAF)	Radio observations as probe for mass loss and shaping in LBVs. 1.3, 2, 6 cm	1.50
AW671	Wrobel, J. (NRAO) Terashima, Y. (ISAS) Ho, L. (Carnegie)	LLAGN candidates. 3.6, 6 cm	11.56

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
AW675	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. (UC, Berkeley) Ryder, S. (AAO)	Triggered observations of type II SNe. 1.3, 2 cm	5.41
AW678	Wucknitz, O. (JIVE) Czoske, O. (Bonn) Schmidt, R. (Potsdam) Garrett, M. (JIVE)	Possible jet in massive lensing cluster of galaxies C10024+1654. 20 cm	7.08
AW681	Willson, R.F. (Tufts)	Solar metric and decimetric bursts. 90, 400 cm	11.58
AY163	Yi, J. (KASI) Booth, R. (Onsala) Conway, J.E. (Onsala)	Joint VLA/VLBA observations of SiO masers in two Miras. 0.7 cm	6.54
AY164	Yun, M. (Massachusetts) Scott, K. (Massachusetts) Wilson, G. (Massachusetts) Yan, L. (Caltech) Choi, P. (Caltech) Frayer, D. (Caltech)	Imaging the FLS Verification Strip. 20 cm	74.22
AZ166	Zapata, L. (CfA) Ho, P. (CfA) Rodriguez, L. (MEXICO/UNAM)	Search for companion to AB Au. 3.6 cm	8.09
AZ167	Zijlstra, A. (Manchester) Hajduk, M. (UMIST) Kerber, F. (ESO) vanHoof, P. (Queens) Pollaco, D. (Queens) Evans, A. (Keele) Eyres, S. (Lancashire) Kimeswenger, S. (Innsbruck)	Monitoring spectral indices of Sakurai's object and CK Vul. 3.6, 6 cm	12.86
AZ168	Zhang, Q. (CfA) Keto, E. (CfA) Ho, P. (CfA)	Molecular kinematics across surface of a hyper compact HII region. 1.3 cm	14.04

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
BB219	Bietenholz, M. (York) Bartel, N. (York) Rupen, M. (NRAO)	Unusual type Ib/c SN and GRB Candidate SN. 3.6 cm	9.54
BD114	Dougherty, S. (DRAO) Pittard, J. (Leeds) O'Connor, E. (UPEI) Beasley, A. (NRAO) Claussen, M. (NRAO)	Structural monitoring of colliding-wind binary WR140. 2, 3.6, 6 cm	13.49
BF089	Forbrich, J. (MPIfR) Massi, M. (MPIfR) Ros, E. (MPIfR) Menten, K. (MPIfR)	Non-thermal emission from protostars. 3. 6 cm	3.05
BK114	Kondratko, P. (CfA) Greenhill, L. (CfA) Moran, J. (CfA) Reid, M. (CfA)	Imaging three NGC 4258-like water megamasers. 1.3 cm	12.37
BK127	Knudsen, K. (MPIA)	Imaging two submm-bright quasars at redshift 2.8 cm	5.67
BM241	More, A. (MPIfR) Porcas, R. (MPIfR) Garrett, M. (JIVE) Nair, S. (Raman)	Imaging gravitational lens 2016+112. 2, 3.6 cm	5.89
BP132	Patience, J. (Caltech) Pihlstrom, Y. (UNM) Prato, L. (Lowell)	Measuring the distance to the intriguing Young Star AS353. 6 cm	1.62
BY021	Yi, J. (KASI) Booth, R. (Onsala) Conway, J. (Onsala)	Observations of extended emission in circumstellar SiO masers. 0.7 cm	0.32
GB058	Bartel, N. (York) Rupen, M. (NRAO) Bietenholz, M.F. (York) Beasley, A. (NRAO) Graham, D. (MPIfR) Altunin, V. (JPL) Venturi, T. (Bologna) Umana, G. Noto) Cannon, W. (York) Conway, J. (Onsala)	Structural and spectral evolution of SN 1993J. 6, 20 cm	8.77

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5. VLA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
S60570	Audard, M. (Columbia) Briggs, K. (Paul Scherrer) Brown, A. (CASA) Gizis, J. (Delaware) Guedel, N. (Paul Scherrer) Osten, R. (NRAO) Telleschi, A. (Paul Scherrer)	Chandra observations. 3.6 cm	4.87
S70601	Forman, W. (CfA)	Chandra observations of Galaxy IC 1262. 90 cm	8.10
S70702	Miller, J. (CfA) Fabian, A. (Cambridge) Reynolds, C. (Maryland) vanderKlis, M. (Amsterdam) Wijnands, R. (Amsterdam) Rupen, M. (NRAO) Steeghs, D. (CfA) Charles, P. (Southampton) Raymond, J. (CfA) Homan, J. (MIT) Lewin, W. (MIT)	Triggered Chandra/VLA observations of BH transient in outburst. 3.6, 6 cm	2.14
S70810	Miller, J. (CfA)	Chandra observations of neutron-star binaries. 3.6, 6 cm	5.58
S70998	Miller, J. (CfA) Markoff, S. (MIT) Nowak, M. (MIT) Rupen, M. (NRAO) Steeghs, D. (CfA)	Chandra observations of LLAGN M81*. 3.6 cm	4.21

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6. VLBA OBSERVING PROGRAMS

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

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

No.	Observer(s)	Programs	Hours Observed
BA078	Agudo, I. (MPIfR) Bach, U. (Torino) Gomez, J.L. (IAA, Spain) Krichbaum, T. (MPIfR) Roy, A. (MPIfR) Witzel, A. (MPIfR) Zensus, J.A. (MPIfR)	Monitoring NRAO 150 with multi-frequency polarimetry. 0.7, 2 cm	12.0
BA080	Asada, K. (NAOJ) Inoue, M. (NAOJ)	Tri-monthly monitoring observations of helical magnetic field 3C 273 jet. 2, 3.6 cm	8.0
BB182	Bach, U. (MPIfR) Krichbaum, T. (MPIfR) Middelberg, E. (MPIfR) Witzel, A. (MPIfR) Zensus, J.A. (MPIfR)	Finding nucleus in Cygnus A. 2 cm	11.75
BB219	Bietenholz, M. (York) Bartel, N. (York) Rupen, M. (NRAO)	Unusual type Ib/c Supernova and GRB Candidate SN 2001 em. 3.6 cm	12.0
BB200	Brunthaler, A. (JIVE) Falcke, H. (ASTRON) Greenhill, L. (CfA) Henkel, C. (MPIfR) Reid, M. (CfA)	Geometric distance to M33. 1 cm	5.0
BB220	Boboltz, D. (USNO) Driebe, T. (MPIfR) Ohnaka, K. (MPIfR) Wittkowski, M. (ESO)	Coordinated VLBA/VLTI observations of GX Mon. 0.7 cm	5.0

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6. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
BB222	Bower, G. (UC, Berkeley) Basri, G. (UC, Berkeley) Bolatto, A. (UC, Berkeley) Ford, E. (UC, Berkeley) Goldston, 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. 4 cm	22.0
BB223	Bartel, N. (York.) Bietenholz, M. (York)	Expansion and deceleration of SNR 41.9+58. 1.3 cm	11.8
BB225	Bartkiewicz, A. (Torun) Brunthaler, A. (MPIfR) Szymczak, M. (Torun) vanLangevelde, H. (JIVE)	Nature of methanol maser ring around a young massive star. 2 cm	10.0
BC142	Claussen, M. (NRAO) Morris, M. (UC, Los Angeles) Sahai, R. (JPL) Sanchez-Contreras, R. (OVRO)	Water masers in newly discovered proto-planetary nebula. 2 cm	6.25
BC152	Claussen, M. (NRAO) Marvel, K. (AAS) Simpson, C. (Wellesley) Wilking, B. (UMSL) Wootten, H. (NRAO)	Parallax and proper motions of water masers in Ophiuchus molecular cloud complex. 1 cm	5.0
BC160	Charlot, P. (Obs. De Bordeaux) Djannati-Atai, A. (College de France) Gabuzda, D. (Cork) Lichti, G. (MPIfE) Sol, H. (Meudon)	Coordinated VLBA polarization, INTEGRAL, and TeV observations of gamma-ray emitting blazar Mkn 421. 1.3, 2 cm	14.0
BC161	Cotton, W. D. (NRAO) Danchi, W. (NASA) Lacasse, M. (CfA) Ragland, S. (CfA) Schloerb, F.P. (Massachusetts) Townes, C. (UC, Berkeley) Traub, W. (CfA)	Observations of Miras with photospheric asymmetries II. 0.7 cm	20.0

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6. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
BD114	Dougherty, S. (DRAO) Pittard, J. (Leeds) O'Connor, E. (UPEI) Beasley, A. (NRAO) Claussen, M. (NRAO)	Structural monitoring of colliding-wind binary WR140. 4, 6 cm	12.0
BD117	Dhawan, V. (NRAO) Mioduszewski, A. (NRAO) Rupen, M. (NRAO)	Sitting, spitting, and spinning? LSI=61-303 revisited. 2, 3.6 cm	5.50
BF075	Filho, M. (CNR) Barthel, P. (Kapteyn) Nagar, N. (Kapteyn)	Jets in composite LINER/HII nuclei. 2, 6, 13, 18 cm	16.75
BF089	Forbrich, J. (MPIfR) Massi, M. (MPIfR) Ros, E. (UC, Berkeley) Menten, K. (UC, Berkeley)	Non-thermal emission from protostars. 3.6 cm	4.50
BF090	Fomalont, E. (NRAO) Fey, A. (USNO) Gordon, D. (NASA/GSFC) Lanyi, G. (JPL) Ma, C. (NASA)	ICRF and phase referencing. 4, 13 cm	6.75
BG164	Guglicucci, N. (Virginia) Giroletti, M. (INAF) Peck, A. (SMA) Taylor, G. (UNM)	Investigating Faraday screens for two compact symmetric objects. 2, 4 cm,	15.6
BG166	Golden, A. (NUI) Bourke, S. (NUI) Brisken, W. (NRAO) Chatterjee, S. (CfA)	Measuring distance to CTB 80 Pulsar B1951+32. 6, 20 cm	3.0
BH135	Harris, D.E. (SAO) Cheung, C.C. (MIT) Junor, W. (LANL)	Flare decay of Knot 'HST-1' in M87 Jet. 20 cm	10.80
BH136	Hachisuka, K. (MPIfR) Brunthaler, A. (JIVE) Hagiwara, Y. (NAOJ) Menten, K. (MPIfR) Mochizuki, N. (ISAS) Reid, M. (CfA)	Astrometry of H_20 maser sources in outer part of the galaxy. 1.3 cm	18.0

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6. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
BH142	Helfand, D. (Columbia) Brisken, W. (NRAO) Camilo, F. (Columbia) Chatterjee, S. (CfA) Halpern, J. (Columbia) Ransom, S. (NRAO) Zimmerman, N. (Columbia)	First magnetar proper motion from the transient AXP XTE J1810-197. 4, 6 cm	4.0
BK114	Kondratko, P. (Harvard) Greenhill, L. (CfA) Moran, J. (CfA) Reid, M. (CfA)	Imaging three NGC 4258-like water megamasers. 1.3 cm	15.0
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. 18 cm	7.25
BK131	Kanekar, N. (NRAO) Lane, W. (NRL)	Compact structure of QSOs behind damped Lyman-alpha systems. 90 cm	32.0
BL128	Loinard, L. (MEXICO/UNAM) Mioduszewski, A. (NRAO) Rodriguez, L. (MEXICO/UNAM) Torres, R.M. (MEXICO/UNAM)	Distance for Taurus and Ophiuchus. 4 cm	36.25
BL137	Lister, M. (Purdue) Aller, J. (Michigan) Aller, M.F. Michigan) Arshakian, T. (MPIfR) Homan, D. (Denison) Kadler, M. (MPIfR) Kellermann, K. (NRAO) Kovalev, Y.Y. (NRAO) Lobanov, A. (MPIfR) Ros, E. (MPIfR) Vermeulen, R. (ASTRON) Zensus, J.A. (MPIfR)	MOJAVE II. 2, 4 cm	96.0

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6. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
BL139	Lobanov, A. (MPIfR) Alef, W. (MPIfR) Arshakian, T. (MPIfR) Chavushyan, V. (INAOE) Mercado, A. (INAOE) Shapovalova, A. (SAO, Russia)	Parsec-scale radio emission, accretion disk and broad line region in 3C 390.3. 1, 2, 0.7 cm	8.0
BL142	Loinard, L. (MEXICO/UNAM) Mioduszewski, A. (NRAO) Rodriguez, L. (MEXICO/UNAM) Torres, R. (MEXICO/UNAM)	Very accurate dynamical mass of a pre-main sequence. 2 cm	4.04
BM229	Marscher, A. (Boston) Aller, M.F. (Michigan) D'Arcangelo, F. (Boston) Jorstad, S. (Boston) McHardy, I. (Southampton)	Probing compact jets through multi-waveband variability and polarization. 0.7 cm	32.0
BM230	Marscher, A. (Boston) Aller, M.F. (Michigan) Jorstad, S. (Boston) McHardy, I. (Southampton) Wannawichian, S. (Boston)	Relation between X-ray state and energy flow into jets of radio galaxies. 0.7 cm	20.0
BM235	Moellenbrock, G. (NRAO) Beasley, A. J. (NRAO) Claussen, M. (NRAO) Goss, W.M. (NRAO)	Parallax and proper motions of galactic water masers. 1 cm	18.0
BM241	More, A (MPIfR) Porcas, R. (MPIfR) Garrett, M. (JIVE) Nair, S. (Raman)	Imaging the gravitational lens 2016+112 at 8.4 and 15 GHz. 4 cm	7.75
BM244	Moscadelli, L. (Oss. Di Cagliari) Beltran, M. (Barcelona) Cesaroni, R. (Arcetri) Codella, C. (IRA) Furuya, R. (Caltech) Goddi, C. (Oss. Di Cagliari)	Gas kinematics around high-mass YSOs explored via maser associations. 1.3 cm	28.25

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6. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
BM245	Marscher, A. (Boston) Jorstad, S. (Boston) D'Arcangelo, F. (Boston) Gear, W. (Cardiff) Hagen-Thorn, V. (St. Petersburg) Smith, P. (ASU) Larinova, V. (St. Petersburg)	Blazar monitoring during a ten -day submm/ir/optical campaign. 0.7 cm	16.0
BM247	Marscher, A. (Boston) Aller, M.F. (Michigan) Chatterjee, S. (CfA) Jorstad, S. (Boston) McHardy, I. (Southampton)	Relation between the X-ray state and energy flow into jets of radio galaxies. 0.7 cm	10.0
BM248	Marscher, A. (Boston) Aller, M.F. (Michigan) D'Arcangelo, F. (Boston) Hagen-Thorn, V. (St. Petersburg) Jorstad, S. (Boston) Larionov, V. (St. Petersburg) McHardy, I. (Southampton)	Probing compact jets through multi-waveband variability and polarization. 0.7 cm	14.5
BO026	O'Brien, T. (Manchester) Bode, M. (JMU) Davis, R. (Manchester) Evans, A (Keele) Eyres, S. (Lancashire) Porcas, R. (MPIfR)	Resolving the radio emission from 2006 outburst of recurrent nova RS Ophiuchi. 6, 20 cm	21.4
BO027	O'Brien, T. (Jodrell Bank) Beswick, R. (Jodrell Bank) Bode, M. (JMU) Eyres, S. (Lancashire) Garrington, S. (Jodrell Bank) Muxlow, T. (Jodrell Bank) Porcas, R. (MPIfR)	Monitoring the expanding radio remnant of RS Oph. 20 cm	64.5
BP124	Punsly, B. (Boeing) Ulvestad, J. S. (NRAO) Wrobel, J. (NRAO)	Imaging the inner I parsec of Mrk 231. 0.7, 2 cm	8.0

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6. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
BP125	Petrov, L. (NVI) Fomalont, E. (NRAO) Gordon, D. (NASA) Honma, M. (NAOJ) Kobayashi, H. (NAOJ) Kovalev, Y.Y. (NRAO)	GaPS: Galactic Plane Survey. 1 cm	48.0
BP128	Peck, A. (CfA) Marrone, D. (CfA) Myers, S. (NRAO) Taylor, G. (UNM) Zavala, B. (USNO)	Multi-wavelength analysis of record outburst in 3C454.3. 4 cm	18.0
BP130	Perez-Torres, M. (IAA, Spain) DeBreuck, C. (ESO) deVries, W. (IGPP) Miley, G. (Leiden) Overzier, R. (Leiden) vanBreugel, W. (IGPP)	Imaging of high-redshift radio galaxy TN 1338-1942. 20 cm	8.0
BR100	Reid, M. (CfA) Greenhill, L. (CfA) Menten, K. (MPIfR) Moscadelli, L. (Oss. Di Cagliari) Xu, Y. (Nanjing) Zheng, X.W. (Nanjing)	Spiral structure and kinematics of Milky Way. 2 cm	40.0
BR106	Reid, M. (CfA) Menten, K. (MPIfR)	Enigmatic star VY Cma. 0.7 cm	8.25
BR119	Ros, E. (MPIfR) Aller, H.D. (Michigan) Aller, M. (Michigan) Angelakis, E. (MPIfR) Irwin, J. (Michigan) Kadler, M. (NASA) Kaufman, S. (Argelander)	NGC 1052, key to explore disk-jet connection. 0.7 cm	6.0

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6. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
BR122	Ros, E. (MPIfR) Aller, H.D. (Michigan) Aller, M. (Michigan) Kadler, M. (NASA) Kellermann, K. (NRAO) Kovalev, Y. Y. (NRAO) Lister, M. (Purdue) Lobanov, A. (MPIfR) Miller, R. (Georgia State) Norris, J. (NASA) Sambruna, R. (NASA) Savolainen, T. (Tuorla) ◎.C., K. (Tuorla) Zensus, Z.A. (MPIfR)	Catching the flare in CTA 102. 0.7, 2, 4, 6, 13 cm	12.0
BS150	Savolainen, T. (Tuorla) Rastorgueva, E. (Tuorla) Valtaoja, E. (Tuorla) Valtonen, M. (Tuorla) ◎.C., K. (Tuorla)	Multi-frequency polarimetric VLBA monitoring of next predicted outburst in OJ287. 0.3, 0.7, 2, 4 cm	8.0
BS158	Shen, Z.-Q. (Shanghai) Ho, P. (CfA) Lo, K.Y. (NRAO) Miyazaki, A. (Shanghai) Miyoshi, M. (NAOJ) Tsuboi, M. (NAOJ) Tsutsumi, T. (NAOJ) Zhao, J. (CfA)	Monitoring temporal variation in structure of Sgr A* with VLBA. 0.3, 0.7 cm	21.0
BS166	Szymczak, M. (Torun) Bartkiewicz, A. (Torun) Diamond, P. (Jodrell Bank) Gerard, E. (Obs. De Paris)	Polarized OH outburst in a proto-planetary nebulae. 20 cm	12.0
BS167	Sokoloski, J. (CfA) Brocksopp, C. (MSSL) Kaiser, C. (Southampton) Mioduszewski, A. (NRAO) Rupen, M. (NRAO)	Expanding shell and jet of RS Ophiuchus. 13, 20 cm	4.0

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6. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
BT085	Taylor, G. (UNM) Blandford, R. (Stanford) Fassnacht, C. (UC, Davis) Michelson, P. (Stanford) Myers, S. (NRAO) Pearson, T. (Caltech) Readhead, T. (Caltech) Romani, R. (Stanford) Sjouwerman, L. (NRAO) Ulvestad, J. S. (NRAO) Walker, R.C. (NRAO) Weintraub, L. (Caltech)	Imaging and polarimetric survey (VIPS). 6cm	77.0
BU031	Ulvestad, J. S. (NRAO) Neff, S. (NASA)	Search for young supernovae in Antennae Galaxies. 13 cm	5.0
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 cm	10.0
BW082	Walker, R.C. (NRAO) Hardee, P. (Alabama) ◎.C.◎n, B. (LANL) Ly, C (UC, Los Angeles)	Pilot project for M87 movie at 43 GHz. 0.7 cm	60.0
BY021	Yi, J. (KASI) Booth, R. (Onsala) Conway, J. (Onsala)	Joint VLA/VLBA observations of SiO masers in two Miras. 0.7 cm	8.50
RDV056	Johnston, K. (USNO) Fey, A. (USNO) Ma, C. (NASA) Gordon, D. (NASA/GSFC) Boboltz, D. (USNO) Kingham, K. (USNO) Behrend, D. (NASA/GSFC) Gipson, J. (NASA/GSFC) MacMillan, D. (NASA/GSFC) Petrov, L. (NASA/GSFC) Fomalont, E. (NRAO) Walker, R.C. (NRAO)	Geodesy/astrometry observations for 2006. 3.6 cm	25.0

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6. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
GA022	Agudo, I. (IAA, Spain) Krichbaum, T. (MPIfR) Gomez, J-L. (IEEC) Bach, U. (Torino) Bremer, M. (Bristol) Witzel, A. (MPIfR) Zensus, J.A. (MPIfR)	Polarimetric monitoring of NRAO 150. 0.3 cm	15.0
GB058	Bartel, N. (York) Rupen, M. (NRAO) Bietenholz, M. (York) Beasley, A. (NRAO) Graham, D. (MPIfR) Altunin, V. (JPL) Venturi, T. (Bologna) Umana, G. (Noto) Cannon, W. (York) Conway, J. (Onsala)	Structural and spectral evolution of SN 1993J. 6 cm	12.0
GD021	Diamond, P. (Jodrell Bank) Lonsdale, C.J. (Haystack) Thrall, H. (Jodrell Bank) Lonsdale, C. (Caltech) Smith, H. (CfA) Conway, J. (Onsala) Parra, R. (Onsala)	Monitoring evolution of compact emission of Arp 220. 18 cm	14.0
GD022	Dodson, R. (ISAS) Agudo, I. (IAA, Spain) Krichbaum, T. (MPIfR) Thum, C. (IRAM) Wiesemeyer, H. (MPIfR) Rioja, M. (OAN) bremen, M. (Bristol)	Polarization observations with GMVA. 0.3 cm	19.5
GK033	Krichbaum, T. (MPIfR) Graham, D. (MPIfR) Alef, W. (MPIfR) Witzel, A. (MPIfR) Zensus, J.A. (MPIfR) Bremer, M. (Bristol) Grewing, M. (IRAM)	Structural monitoring of M87. 0.3 cm	13.0

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6. VLBA OBSERVING PROGRAMS

No.	Observer(s)	Programs	Hours Observed
GK035	Krichbaum, T. (MPIfR) Agudo, I. (IAA, Spain) Savolainen, T. (Tuorla) Wiik, W. (Tuorla) Alef, W. (MPIfR) Graham, D. (MPIfR) Witzel, A. (MPIfR) Zensus, J.A. (MPIfR) Bremer, M. (Bristol) Wiesemyer, H. (MPIfR) Grewing, M. (IRAM) Ungerechts, H. (IRAM)	Imaging 3C 454.3 after a major outburst. 0.3 cm	12.5
GM062	Orienti, M. (Bologna) Morganti, R. (ASTRON) Dallacasa, D. (Bologna) Oosterloo, T. (ASTRON)	Imaging the very broad HI absorption in radio galaxies. 18 cm	12.0
GR026	Rastorgueva, E. (Tuorla) ◎.C., K. (Tuorla) Savolainen, T. (Tuorla) Takalo, L. (Tuorla) Krichbaum, T. (MPIfR)	Monitoring the next predicted outburst in OJ287. 0.3 cm	12.5

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ALLER, H.D.; ALLER, M.F.; HUGHES, P.A.; HOMAN, D.C.; WARDLE, J.F.C.; ROBERTS D.H. "Observations of Oblique Polarization Structures in Active Extragalactic Radio Jets."

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APPONI, A.J.; HALFEN, D.T.; ZIURYS, L.M.; HOLLIS, J.M.; REMIJAN, A.J.; LOVAS, F.J. "Investigating the Limits of Chemical Complexity in Sagittarius B2(N): A Rigorous Attempt to Confirm 1,3-Dihydroxyacetone."

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ARGO, M.K.; PEDLAR, A.; MUXLOW, T.W.B.; BESWICK, R.J.; AALTO, S;, WILLS, K.; BOOTH, R.S. "OH in Messier 82."

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ASADA, K.; INOUE, M.; KAMENO, S.; NAGAI H. "A Helical Magnetic Field in 3C 273."

ATTRIDGE, J.M.; WARDLE, J.F.C.; HOMAN, D.C.; PHILLIPS R.B. "Concurrent 43 and 86 GHz VLBA Polarimetry Observations of the Quasars 3C273 and 3C279."

AVALOS, M.; LIZANO, S.; RODRÍGUEZ, L.F.; FRANCO-HERNÁNDEZ, R.; MORAN, J.M. "Spectra and Sizes of Hypercompact H II Regions."

BACH, U.; KADLER, M.; KRICHBAUM, T.P.; MIDDELBERG, E.; ALEF, W.; WITZEL, A.; ZENSUS, J.A. "Multi-Frequency & Multi-Epoch VLBI Study of Cygnus A."

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PROJECTS

1. EVLA

Expanded Very Large Array Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Project book updated	02/28/06	03/31/06	03/31/06
2. Test focus change with elevation	04/03/06		04/03/06
3. Correlator face-to-face meeting	04/05/06		04/05/06
4. Document Doppler-tracking workaround	04/10/06		04/14/06
5. Implement F317 software functionality	04/11/06		04/14/06
6. Determine polarization properties of L-Band feed	04/10/06		04/20/06
7. Project data model meeting with ALMA	04/20/06		04/20/06
8. Improve automatic level setting (hardware)	05/08/06		04/20/06
9. 1.5 GHz wideband receiver lab test complete	02/03/06	04/15/06	04/21/06
10. Front Ends CDR	03/05/05	04/24/06	04/24/06
11. Evaluate round-trip monitor data, L352-353	04/12/06		04/25/06
12. VLA antenna setup with Observation Executor	10/14/05	05/31/06	05/01/06
13. Total-power detector added to baseband converter	02/15/06	04/20/06	05/03/06
14. L302 module firmware updated and tested	02/28/06	04/14/06	05/04/06
15. Begin feed-moisture monitoring	04/13/06		05/04/06
16. EVLA Advisory Committee Meeting	05/08/06		05/08/06
17. New release of proposal submission tool	05/10/06		05/10/06
18. NSF EVLA Review Meeting	05/11/06		05/11/06
19. 4 IFs on Antenna 18 working	12/13/05	05/06/06	05/16/06
20. Antenna 18 with 4 IF-bands working	05/03/06		05/16/06
21. Correlator shielded-chamber flooring installed	05/12/06		05/18/06
22. Complete M302-3 functionality tests – hardware	04/10/06		05/19/06
23. M301 module ready to install on antenna	06/08/05	04/15/06	05/23/06
24. Requirements for final version of Observation Executor complete	07/14/05	04/10/06	05/31/06
25. Perform pattern measurements on scaled S-Band feed	05/31/06		05/31/06
26. New release of observation preparation tool	06/01/06		06/01/06
27. Start transition-mode observing	03/15/05	06/05/06	06/05/06
28. 4-P converter withM301 ready for use	10/14/05	04/25/06	06/07/06
29. Include current weather data for pointing	06/19/06		06/12/06
30. Initial EVLA antenna OPS checkout procedure available	05/01/06		06/16/06
31. Utility module (M302) prototype installed	03/01/06	04/21/06	06/20/06
32. Environmental stress screening review, correlator chip	06/20/06		06/20/06
33. First correlator chip prototype delivered	11/28/05	05/15/06	06/22/06
34. WBS level 2 budget & schedule reviews	06/27/06		06/27/06
35. C-Band OMT – assembly	07/11/06		
36. New VLA correlator controller operational, controlled from Modcomps	08/30/05	07/14/06	
37. Hardware acceptance tests complete on antenna 18	05/05/06	07/18/06	

PROJECTS

1. EVLA

Milestones	Original Date	Revised Date	Date Completed
38. GUI's available for initial EVLA antenna OPS checkout	06/01/06	07/19/06	
39. Hardware acceptance tests complete on antenna 24	05/23/06	07/27/06	
40. Receiver stability tests: 8, 22 and 45 GHz	12/19/03	07/31/06	
41. Check for interference and bandpass shapes: 8, 22 , and 45 GHz – written report	03/15/04	07/31/06	
42. RTP data multicast from L352, with listener thread in interim Observation Executor	07/29/05	07/31/06	
43. Report on receiver stability, bandpass shapes, linearity of RF design	08/12/05	07/31/06	
44. VLBA data in ALMA science-data model	05/08/06	07/31/06	
45. Prototype correlator installation plan	07/31/06		
46. Specify extensions to EVLA script and obs2script	10/17/05	07/31/06	
47. Improve TP detectors for auto level setting (software)	04/28/06	08/01/06	
48. Investigate probable error in Tsys measurement	06/05/06	08/14/06	
49. Finalize L-Band 3D OMT drawing	08/28/06		
50. L-Band wideband receiver installed	04/21/06	08/30/06	
51. Baseline Board prototype available	08/30/06		
52. ESO-ALMA NGAS hardware—software installed	08/31/06		
53. C-Band OMT —broadband test in receiver	08/31/06		
54. Implement antenna auto phasing	06/05/06	09/05/06	
55. L-Band sensitivity tests with wideband receiver	09/08/06		
56. Agreement on common project software model	09/01/05	09/15/06	
57. Issue FY2007 budget plan	09/15/06		
58. Complete Part 2 hardware bench integration	03/03/03	09/15/06	
59. Updated HLA	05/01/06	09/29/06	
60. New VLA correlator controller controlled from EVLA M&C system	11/30/05	09/29/06	
61. Access to archive tool via portal	06/14/06	09/30/06	
62. OPT outputs a VLA observe script	10/25/06		
63. Archive records written using Modcomp-independent format	03/13/06	12/29/06	

Project Management

The EVLA Advisory Committee met on May 8–9 to review progress on the project. The major recommendations of the committee included developing more quantitative performance metrics for the project, conducting a detailed risk and contingency analysis, closely monitoring the delivery of the WIDAR correlator, accurately determining data-throughput requirements between the correlator and the monitor and control system, and exploring collaborations with ALMA to make significant reuse of ALMA software. An NSF Mid-Project Review was held on May 11–12. The review committee suggested that another review be held in late 2007, possibly in conjunction with the Advisory Committee meeting, to review progress on important milestones (e.g. installation of the prototype correlator and the

retrofitting of a total of 12 antennas to the EVLA design). The semi-annual update of the project's WBS cost data sheets was completed.

Systems Integration

EVLA antennas 13, 14, and 16 are now functioning with four complete Ifs. These antennas are being used by the scientific and technical staff to evaluate the performance of EVLA hardware and software. Additionally, these antennas have been returned to operations, moved out to the array, and are being used in scientific observations by both NRAO and external users. Four IFs are also operational on antenna 18. This antenna contains the production version of the new M301 module that is used to control band switching. It should be returned to operations by late July. Antenna 24 has been outfitted and is operating with two IFs at X-Band. The remaining IF pair will be installed in the antenna in July. Antenna 24 recorded its first fringes in June and is being used as the test bed for the new M302/M303 utility modules. Antenna 26 is nearing completion of its mechanical retrofit and will be outfitted with electronics throughout the month of July.

Civil Construction

Work continues on outfitting the shielded room for the new correlator. The computer flooring contract is approximately 95% complete. The remaining work will be completed after the correlator support framing is installed in early August.

Completion of the FM200 fire suppression system was delayed by the computer floor work and is now scheduled for July. The FM200 will be interlocked with the water sprinkler system, which will act as a backup fire-protection system if the FM200 fails to extinguish a fire.

The installation of power distribution equipment and cabling in the correlator room is complete. The HVAC equipment for the correlator room was installed in May. Power and plumbing are being routed to the HVAC equipment and will be complete in July. The insulation contract for the HVAC plumbing will be completed in August. Room lighting is installed and will be wired in early July. The installation of the correlator power plant is tentatively set for the first quarter of 2007.

Antennas

The mechanical outfitting of antenna 26 is nearly complete. The fabrication of mechanical components for the next three EVLA antennas has begun.

The fiberglass lamination of L-Band feed horns 1 through 12 is complete. The lamination of horn 13 is in progress. Feed moisture detectors on antenna 13 are being monitored, and more detectors are ready to install on antenna 16.

All but three C-Band feed horns are assembled and stored in the cold-storage warehouse. Storage fixtures have been designed for the L-Band horns. To date, one (of four) has been built and utilized.

Front End

PROJECTS

1. EVLA

The critical design review (CDR) for Front-End Systems was held on April 24–25. Overall, the CDR panel felt that the definition of the front-end requirements for this portion of the EVLA project was comprehensive and realistic, and that for the most part the designs selected appear to meet the Project Book requirements, thus allowing hardware production to proceed in most areas. The panel was impressed with the efficiency of the cryogenic developments and indicated that the front-end test facilities were well thought out and effective. Several suggestions were provided for reducing the excess noise measured in the L-Band prototype OMT. The panel also made a number of general recommendations, including the need to apply more technical resources to the L-Band OMT, carry out further investigations of waveguide window material, and review the protection circuits used for the indium phosphide (InP) low-noise amplifiers.

Antenna 18, the fourth EVLA antenna to be upgraded, received its interim C- and Q-band front ends during this period, while the next newly outfitted antenna (#24) had its L-, X-, and K-band receivers installed. Antenna 26, now in the antenna assembly building, had its old receiver systems removed. Its new cable trays are now being installed in the vertex cabin.

A revised AC relay card for controlling each receiver's vacuum and cryogenic system was prototyped and evaluated. The first new front-end monitor and control module (F317) is currently undergoing checkout in the lab. The responsibility for assembling the utility rack (formerly known as the FE-rack), has been transferred to the Cryogenics Group at the VLA. This will provide more workspace and manpower resources for receiver production in the front-end laboratory at the Array Operations Center.

A half-size S-band prototype feed was tested on an outdoor antenna test range located on the New Mexico Tech campus. The measured beam patterns and VSWRs agree well with theoretical projections. A full-size feed will now be built.

Local Oscillator System

All LO modules are in or moving into full production. The new version of the L352 round-trip-phase measurement module is being tested on the EVLA antennas. The module meets all specifications. The antenna system is showing some fringe amplitude drop-outs which are thought to be caused by the L302 synthesizer. Details of this problem are still under study. Builds of the central reference generator (L350) and master offset generator (L351) should be complete by the fourth quarter of 2006. This will complete the build of all master LO modules.

Fiber Optics

The Digital Transmission System (DTS) modules, the formatter, and the de-formatter continue to be built to meet the antenna outfitting schedule. Antenna 26 is outfitted with fiber-optic cable. The remainder of the fiber cables in the vertex room will be installed after the LO and utility racks are installed.

The prototype design of the 3-bit 4-GHz sampler is complete, and a circuit card for the sampler has been designed, built, and received. The board will be populated and tested in August when the Rockwell sampler chip arrives. This prototype design will be used to help the project determine if it will use the Rockwell-based design or the existing ALMA design.

Delivery of the half transponders (transmit side) will begin in July. The vendor will deliver 15 sets of 12 (one antenna's worth) over the next 12 months. This will complete the procurement of half transponders for the project.

Intermediate Frequency System

All IF modules are in full production. The first 4P converters (T301) to convert RF in the 4- and P-bands to the 8–12 GHz IF were built and installed in antennas. The LSC converters (T302) for the L, S, and C bands have been used for some time. An isolation problem with the local oscillator in the T302 has been identified and will be addressed in the third quarter of 2006. The installation of the UX converter for the U and X bands is awaiting the fabrication of new housings. The down converters (T304/305) have the total-power digitizers installed and are functioning in several antennas.

Correlator

Ten packaged correlator-chip prototypes were delivered to Penticton on June 10. These prototypes will be tested to ensure there are no packaging problems before the 200 remaining prototypes are packaged. The baseline-board printed circuit board (PCB) fabrication has not yet been successful due to improper attention being paid to the stackup of the board by the PCB fabrication house. We have nearly completed the re-design of a couple of internal layers that will address and fix this problem. As a backup position, quotations for PCB board fabrication from other sub-contractors will be sought on the re-designed board. This mistake by the PCB fabrication house has stretched an original 8-week lead-time for board fabrication and assembly to more than 20 weeks

The order for the first station-board prototype has been placed, with a quoted 8-week lead time from the June 29 order date. The build is simpler than the baseline board, so we don't anticipate having the same problems.

Monitor & Control (M&C)

The installation of downconverter (T304/305) modules with functioning total-power detectors began in late May. Antennas 14, 16, and 24 are now equipped with these dow converters. Low-level driver software for the total-power detectors is in place and functioning. Level-setting software, which builds on the total-power detector functionality, is under development.

The first M301 module, needed for full computer-controlled band switching, was installed in antenna 18 in late May. A full functional test of the software and hardware was performed before installation in the antenna. The hardware and software are working as expected.

The M302 and M303 utility modules, responsible for a variety of functions in the antennas including critical power resets, fire alarms, some environmental monitoring and wyemon (array monitoring) functions, such as emergency stops, are nearing completion. The M302 and M303 are scheduled for functional antenna tests in July. The needed device-level software for the M302 and M303 is ready. Trial versions of the user-interface software for the M302 and M303, including device-specific screens and a

wyemon replacement screen, were included in the latest release of the EVLA Operator Software on June 14. For safety reasons, the wyemon replacement screen will run on a standalone computer system. The needed system has been ordered.

A command-line version of the antenna checkout software that is to be used by the operators for antenna checkout and antenna acceptance has been released to Operations and will soon be tested by the VLA Operators. A GUI-based version of this software will be developed and is currently scheduled for release sometime in late July.

Development work has begun on Interim DCAF (IDCAF), the software that will format and write VLA-format archive records from the EVLA M&C System.

Work has begun that will soon lead to enabling a realtime monitor data stream (the observing stream or ostream). This data stream is distinct and different from the monitor data stream that goes to the archive. The ostream will be used to support a variety of functions within the M&C system, including round-trip-phase corrections and real-time use of the total-power measurements, and to supply some of the metadata needed by the IDCAF software component.

Science Support Systems

After the creation of the observatory-wide End-to-End Operations Division (EOD), Science Domain Software was renamed Science Support Systems (SSS). The division of responsibilities between EVLA Computing and the EOD is currently being developed.

The High-Level Architecture effort continues to concentrate on the development of models for its various components. These models will be used by all SSS subsystems. The first application to use these models is the Observation Preparation Tool (OPT). The current Proposal Submission Tool (PST) requires only minor modifications.

A second release of the VLA proposal tool took place in May 2006, when 120 proposals (90 of which were submitted in the final 12 hours) were received.

The first release of the OPT was made. The OPT is mainly a GUI shell, and a plan exists to develop its underlying functionality in the coming months. It uses models and objects that are developed as part of the High Level Architecture.

Work is under way to bring up the ESO/ALMA NGAS hardware and software. Potential exists for borrowing much of the ALMA archiving software for EVLA.

2. NEW INITIATIVES

Square Kilometer Array (SKA)

The four proposals from Argentina, Australia, China, and South Africa to locate the SKA are being evaluated with the goal of producing a short list of acceptable sites. A preliminary analysis of the issues facing SKA operations has been completed and will be presented to the International SKA Steering Committee (ISSC) later this summer. The feasibility of hosting the International SKA Project Office at NRAO during the period 2007–10 is being evaluated. Discussions with the U.S. SKA Consortium continue to address the question of the level of U.S. participation in the SKA project and the corresponding level of funding to support the International SKA Project Office.

The Long Wavelength Array (LWA)

NRAO has finished its subcontract to help the LWA project install its prototype station, the Long Wavelength Demonstrator Array (LWDA). The electronics control container and the first 16 dipole antennas are in place; power is on; and a fiber connection has been established between the LWDA and the VLA control building.

The Frequency Agile Solar Radio Telescope (FASR)

FASR design and development continues. Significant progress was made earlier this year on refining science and engineering specifications of the instrument, defining the FASR reference instrument, identifying R&D targets, and addressing operations and maintenance issues. More recently, however, progress has been severely hampered by delays in receipt of NSF funds and their disbursement by the NRAO through subcontracts to partner institutions.

Space VLBI

We have continued discussions with both the Russian RadioAstron and Japanese VSOP-2 mission planners in preparing for the missions including the potential use of NRAO facilities, in particular the VLBA and the GBT. The VLBA, in particular, is considered to be an essential component of RadioAstron and VSOP-2, and the mission planners have been informed about the uncertain status of the VLBA in the 2008 to 2015 time frame being considered for these missions. The multifrequency synthesis software package developed at the Russian AstroSpace Center has been tested, with encouraging results.

OPERATIONS

1. GREEN BANK OPERATIONS

GBT Milestones

GBT Antenna & Operations (Azimuth Track Project)

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	05/01/07		

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

GBT Electronics

Milestones	Original Date	Revised Date	Date Completed
1. Spectrometer LTA redesign decision point	05/15/06	05/24/06	05/24/06
2. GBT RFI monitor station complete	09/01/06		
3. Q-band receiver upgrade work	10/01/06		
4. Ka-band receiver upgrade work	10/15/06		
6. Design/prototype IF power divider	05/01/06		05/01/06
7. C-band receiver: Design cryostat for 350 refrigerator	05/01/06		05/01/06
8. C-band receiver: Design integrated receiver package	10/01/06		
9. Spectrometer LTA upgrade	10/01/07		

Notes:
1. Completed. See 9 for the resulting project.
3, 4. On schedule.
6. Prototypes successful.
7, 8. Cryostat in fabrication. Integrated receiver design on schedule.

GBT Mechanical Engineering & Central Shop

Milestones	Original Date	Revised Date	Date Completed
1. GBT RFI-antenna mount fabrication	04/14/06		04/14/06
2. Solar-burst antenna	04/14/06	06/30/06	06/23/06
3. ALMA cartridge extender suite	03/31/06	04/14/06	04/17/06
4. EVLA L-band feed towers (2)	06/02/06		04/26/06
5. GB test dewar	04/14/06		04/13/06
6. GBT Ka-band receiver upgrade	08/18/06		
7. Zpectrometer electronics crate	06/01/06	07/21/06	

OPERATIONS

1. GREEN BANK OPERATIONS

Milestones	Original Date	Revised Date	Date Completed
8. 140′ MLLN tunable receiver	08/18/06		
9. C-band receiver refurbishment	08/25/06		

Notes:
1. Antenna mount undergoing electronics outfitting and testing.
2. Solar-burst antenna fabrication completed, antenna mounting interface pending.
4. Three feed towers delivered instead of two.
7. Zpectrometer electronics crate design is complete and fabrication has begun.

GBT Software & Computing

Milestones	Original Date	Revised Date	Date Completed
1. GBTIDL v2.0 with data flagging	03/31/06	04/15/06	05/17/2006
2. Attend joint PST meeting with ALMA/EVLA	04/28/06		04/20/2006
3. Implement single factor (weather queue) dynamic-scheduling prototype	05/15/06		Eliminated
4. Release Zpectrometer software	09/30/06		
5. Implement multi-factor dynamic scheduling prototype	11/15/06		
6. Attend NRAO-wide Software Engineering Conference	08/08/06		
7. Penn Array Receiver manager complete	10/30/06		

Notes:
5. This milestone was dropped because our strategy for dynamic scheduling has evolved. We are now focused on solidifying the proposal for dynamic scheduling and developing the multi-factor prototype.

GBT Projects

Milestones	Original Date	Revised Date	Date Completed
1. Plan PTCS project for next 2 years	06/30/06	07/30/06	
2. Penn Array Receiver full lab integration at Penn	09/06/04	07/2006	
3. Penn Array Receiver GBT commissioning commences	02/21/05	11/2006	
4. Zpectrometer installed on GBT	10/01/06	11/01/06	
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. The Zpectrometer is a collaboration with Andy Harris at the University of Maryland.

OPERATIONS

2. NEW MEXICO OPERATIONS

VLA and VLBA Milestones

Management and Scientific Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Release new version of Proposal Submission Tool (PST)	05/10/06		05/17/06
2. Host NRAO Users Committee	05/18/06		05/18/06
3. Begin dynamic scheduling of all VLA "filler" time	05/18/06		05/18/06
4. VLBA conversion to full-time Mark 5 operations	03/31/06	06/30/06	05/31/06
5. VLA-VLBA proposal deadline	06/01/06		06/01/06
6. AIPS Newsletter released	06/30/06		06/19/06
7. Synthesis Imaging Summer School	06/20/06		06/20/06
8. Return antennas 14 and 16 to operational VLA	05/20/06	08/01/06	
9. Return antenna 13 to operational VLA	08/01/06		
10. Return antenna 18 to operational VLA	08/15/06		
11. Completion of VLA Archive Imaging Pilot Project	01/31/06	08/31/06	
12. Release revised version of VLA/GBT proposal tool	09/10/06		
13. Return antenna 24 to operational VLA	09/15/06		
14. Convert VLA and High/Sensitivity Array to Mark 5	09/30/06		
15. VLA-VLBA proposal and large-proposal deadline	10/02/06		
16. Return antenna 26 to operational VLA	10/31/06		
17. Retire VLA Modcomp computers	03/31/06	12/31/06	
18. AIPS 31DEC06 frozen; 31DEC07 released	12/31/06		

Notes:

1. The Proposal Submission Tool release was delayed slightly to enable maximum bug fixes for VLA. The VLA and GBT tools were split for more effective astronomer usage.

4. The only remaining tape usage on the VLBA is to enable disk input from non-VLBA stations; sufficient disk modules are now on hand to operate the stand-alone VLBA as a full-time Mark 5 array.

8. Delayed to improve interoperability among EVLA and VLA antennas, following input from the NRAO Users Committee about the degree of interoperability and reliability desired by users.

11. Final report delayed; will feed into decisions of new e2e operations group.

17. Competing with EVLA software development and checkout, which take higher priority. This item may be delayed into 2007 so personnel resources can be spent on development for the prototype EVLA correlator.

OPERATIONS

2. NEW MEXICO OPERATIONS

Computer Infrastructure Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Phase 2 of renumber AOC IP address space	02/28/06	04/30/06	04/15/06
2. Host NRAO-wide system administrator meeting	04/30/06		04/30/06
3. Bring up antenna 24 EVLA M&C network	05/30/06		05/20/06
4. Upgrade all NRAO-NM Linux machines to Redhat Enterprise 4	12/31/05	04/30/06	05/30/06
5. Create Gold Book replacement proposal	07/15/06		
6. Conduct requirements survey for calendaring	08/01/06		
7. Generate AOC-VLA link upgrade plan	05/30/06	08/31/06	
8. Establish network tunnel to DRAO	08/31/06		
9. Establish network tunnel to ESO	09/30/06		

Operations Software Support Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Transcribe VLA observe-system files	11/30/02	01/31/07	
2. Translate and copy stored VLA monitor data format from 9-track to DAT	03/01/04	06/30/07	
3. Correlator controller operational by Modcomps	04/04/05	07/14/06	
4. Correlator controller operational by EVLA monitor and control	04/04/05	09/29/06	

Notes: 1, 2. Low priority

Electronics Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Scheduled Maintenance Visit Kitt Peak VLBA (ACU Upgrade)	06/30/06	05/22/06	05/22/06
2. Replaced Maser 13 with Maser 2 at the VLA	06/20/06		06/20/06
3. After 14 months of effort we finally repaired Maser 10	06/20/06		06/20/06
4. Removed the 27 74-MHz Dipoles from VLA	06/28/06		06/28/06
5. Install multi-turn FRM Encoder at Pietown VLBA	07/14/06		
6. Complete a VLA prototype ACU system	07/20/07		
7. Scheduled Maintenance Visit Mauna Kea VLBA (ACU Upgrade)	07/30/06	07/26/06	
8. Upgrade the TAC and Servo Boards at Mauna Kea	07/30/06		
9. Scheduled Maintenance Visit Hancock VLBA (ACU Upgrade)	09/27/06		

Engineering Services Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Complete Antenna 26 Bearing Change (non-EVLA)	08/24/06	05/05/06	05/05/06
2. Complete Kitt Peak VLBA major maintenance	05/22/06		05/22/06
3. Complete BnA-array reconfiguration	05/26/06		05/26/06
4. Complete B-array reconfiguration	06/16/06		06/16/06
5. Complete Mauna Kea VLBA Peak major maintenance	07/26/06		
6. Complete Hancock VLBA Peak major maintenance	09/27/06		
7. Complete CnB-array reconfiguration	09/29/06		
8. Complete C-array reconfiguration	10/20/06		

OPERATIONS

3. NA ALMA Science Center

Completed NAASC Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Generate new WBS for 2006–2013 for internal review	04/01/06	04/10/06	04/21/06
2. Generate new "NA ALMA Ops & NAASC" draft (v0.5) and post with supporting material on website, for review committee	04/04/06		04/04/06
3. Submit Quarterly Report	04/07/06		05/03/06
4. Hold review of NA ALMA Ops and NAASC plan	04/11/06		04/11/06
5. Generate NAASC document for Visiting Committee meeting (April 17–18 in Green Bank)	04/07/06		04/07/06
6. Face-to-face meeting with G. Fahlman and others (NRC) on Canadian involvement in the NA ARC	04/12/06		04/12/06
7. NAASC presentation to theVisiting Committee	04/18/06		04/18/06
8. Participate in NRAO management retreat; strategic planning.	04/19-20/06		04/20/06
9. NAASC presentation to the NSF	04/24/06		04/24/06
10. Generate NAASC document for the Users Committee meeting (May 17–18 2006 in Socorro)	04/28/06		04/28/06
11. ANASAC meeting (agenda; close open items) (meeting rescheduled to 04/28/2006)	04/28/06		04/28/06
12. NAASC organizational meeting	05/03/06		05/03/06
13. Face-to-face meeting with Massimo Tarenghi and the ALMA Operations working group	05/15–16/06		05/16/06
14. Submit AAS proposal for the ALMA Town Meeting at next winter's AAS meeting -> will be single NRAO Town Meeting, to include ALMA	05/15/06		05/15/06
15. NAASC presentation to the Users Committee	05/17/06		05/17/06
16. Organize SOC/LOC for 2nd NAASC workshop on astrophysical disks and astrochemistry	05/30/06	06/30	06/30/06
17. Generate revised NA ALMA Ops and NAASC draft, incorporating comments from review, VC, NSF, and UC meetings. Changed after April 24 meeting with NSF—submit revised proposal to NSF for peer review at the end of September.	06/01/06	09/30/06	Open
18. Generate poster on NAASC, splatalogue (spectral-line catalog), and ALMA Level-1 science goals for the Calgary AAS meeting	06/01/06		06/01/06
19. Submit articles for July 1 NRAO Newsletter	06/05/06		06/05/06
20. Attend Calgary AAS meeting; ALMA special session June 5; posters June 7–8	06/05–08/06		06/08/06

OPERATIONS

3. NA ALMA Science Center

Milestones	Original Date	Revised Date	Date Completed
21. Face-to-face meeting with e2e and NVO to discuss NAASC Archive and VO	06/09/06		06/09/06
22. Tour of UVa Microfabrication lab; discuss ALMA development.	06/12/06		06/12/06
23. Telecon with NRC on Canadian role in ALMA Operations	06/28/06		06/28/06
24. Revise ALMA Operations Plan (with project scientists, project managers, ARC managers, JAO) for next Board meeting	06/30/06		06/30/06
25. ANASAC meeting (new chair, new charges)	06/30/06		06/30/06

NAASC Milestones for the July–September 2006 Quarter

Milestones	Original Date	Revised Date	Date Completed
1. NAASC organizational meeting	07/05/06		
2. Submit Quarterly Report	07/11/06		
3. Set Operations Plan writing assignments	07/20/06		
4. ARC Manager face-to-face meeting at ESO—resolve computation of ARC value	07/22/06		
5. Revise ALMA Operations Budget, including ACA, new staffing ramp/up, and running costs	07/30/06		
6. NAASC organizational meeting: review ARC CSV plan	08/02/06		
7. Tucson face-2-face meeting with NRC; JAO AIV-CSV team.	08/03–05/06		
8. Draft plan for ARC's role in the CSV	08/10/06		
9. New draft NAASC Operations Plan ready for review by e2e, Directors office, NRAO operations	08/15/06		
10. New draft NAASC Operations Plan ready for review by NRC, ANASAC	08/25/06		
11. Arrange for ANASAC face-to-face meeting in Charlottesville; ANASAC telecon	08/25/06		
12. Submit articles for NRAO October Newsletter	09/07/06		
13. ANASAC face-to-face meeting in Charlottesville	09/8–9/06		
14. Participate in ASAC face-to-face meeting (Florence)	09/15–17/06		
15. Set up webpage for NAASC workshop on protoplanetary disks	09/20/06		
16. NAASC Operations Plan internal review	09/22/06		
17. Submit NAASC Operations Plan to NSF	09/30/06		

OPERATIONS

3. NA ALMA Science Center

Long-term NAASC Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Develop plans for 2007–2009 based on construction milestones. What staff/software/documentation must be in place, by when?	08/31/06		06/29/06
2. Revised ALMA Operations plan to Board	10/11/06		
3. Offline software test 2006.10-6	10/30/06		
4. Review of ALMA Operations Plan (and NAASC?) at Madrid Board face-to-face meeting	11/9/06		
5. Plan 2nd NAASC workshop	Fall		
6. Spectral-line catalogue—continue resolving species (135/677 resolved as of 07/01/06)	Ongoing		

4. Central Development Lab

Amplifier Design and Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Evaluation of TRW Cryo-3 devices to determine noise, signal and dc properties at cryogenic temperatures	04/01/04	ongoing	
2. Design/redesign of cryogenic amplifiers using Cryo-3 TRW devices for EVLA, VLBA, GBT, and ALMA covering the frequency range from 1 to 120 GHz	04/01/04	12/31/06	

Notes:
2. A redesign of the 12–18 GHz amplifier to achieve a wider noise and gain performance has been completed and the prototype for 5–20 GHz has been successfully tested. This was done in a collaborative effort with Harvard CfA to develop SIS mixers with extremely wide band IF amplifiers. A redesign of the 18–26 GHz and 26–40 GHz amplifiers to improve gain is proceeding.

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	06/30/06	12/30/06	

Notes:
1 and 2. Second-quarter production totaled 20 new and upgraded amplifiers, including L-, C-, S-, and K-band units for the EVLA and Q-band LNAs for the GBT receiver project.
3. The PC/Labview-based noise-measurement system is operational, producing measured data identical to the old ADIOS system, verifying calibration continuity between the NRAO-built and commercial hardware. We are purchasing hardware to complete two similar systems and will incorporate various software and hardware enhancements as the year progresses.

Other Projects:
The Chemistry Lab plated approximately 20 grams of gold, mostly in support of ALMA construction. That represents a gold value of about $600 and an estimated job cost of $9,000 if done commercially.

4. Central Development Lab

MMIC Design and Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Develop differential LNA for balanced feeds	12/01/06		
2. Develop integrated wideband LNA-feed package	12/01/06		
3. Evaluate Adaptive Digital Image-Rejection approach for wideband downconversion	12/01/06		
4. Design/Revise DSN front-end modules for wider bandwidth	09/30/06		
5. Design wideband downconverter module for the Allen Telescope Array	03/01/07		
6. Package and measure wideband 11–34 GHz LNA	03/01/07		
7. Design GaAs W-band power amplifiers to improve reliability of millimeter/wave local oscillators	03/01/07		

Notes:

1. This is to be a decade-bandwidth low-noise amplifier covering the centimeter-wave band (3–30 GHz). It will have a differential input and output, facilitating its use as an "active balun" for wideband balanced feeds. It will be noise matched to the self-similar log-periodic antenna impedance at the input and to 50 Ω at the output. Such an amplifier will be useful for future wideband centimeter-wave telescope arrays such as the Square Kilometer Array and FASR.
2. To realize the full potential of the above differential LNA, and to facilitate its measurement, it will be necessary to prototype a package and interface between the LNA and the feed that minimizes loss while preserving the high-valued differential impedance over a wide bandwidth.
3. This is a conceptual approach to wideband downconversion using programmable digital sideband-separation that may provide greater image isolation than can be achieved by analog means.
4. This is a collaboration with the Jet Propulsion Lab to extend the bandwidth of their MMIC-based Ka-band downconverter to include a new communication band on the DSN Array.
5. (a) Collaborate with the University of California at Berkeley.
   (b) Develop a multi-chip module for wideband downconversion on the ATA to replace a bulkier non-MMIC unit.
6. (a) Collaborate with the Jet Propulsion Lab and the California Institute of Technology.
   (b) This is a cryogenic MMIC LNA for the US Square Kilometer Array concept. The chip is currently in fabrication.
7. A large number of InP MMIC power amplifiers have been developed by NRAO and its collaborators for local-oscillator subsystems, including ALMA and other programs. However, recent experience has taught us that InP pHEMTs have a disadvantage in terms of long-term reliability when operated in compressed mode. We are therefore developing GaAs-based substitutes for many of these amplifiers. While the reliability of GaAs is well-proven in saturated operation, this will require pushing the technology to higher frequencies than ever before. The design for a new GaAs power amp for ALMA Band 3 (up to 108 GHz) is in progress and will be fabricated in a 0.1 μm pHEMT process at British Aerospace Engineering (BAE) Systems. Future work will include shorter gate-length devices and thinner substrates to further increase the upper frequency limit of GaAs pHEMTs for power applications.

OPERATIONS

4. Central Development Lab

Superconducting Millimeter-Wave Receiver Development Milestones

Milestones	Original Date	Revised Date	Date Completed
350 μm receiver technology development			
1. Demonstrate NbTiN/insulator/Nb tunnel junction	10/01/06		
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	12/31/06	
4. Measure IF characteristics of a diffusion-cooled HEB mixer	06/30/06		

Notes:
1 The first NbTiN trilayer (NbTiN/AlN/Nb) has now been made. A new type of plasma etcher, an Inductively-Coupled Plasma Reactive-Ion Etcher (ICP-RIE), is currently being commissioned and will be used in the photolithographic processing of the NbTiN trilayer material to make tunnel junctions. This project is being done with the University of Virginia Microfabrication Laboratory.
2. The first wafer of IF hybrids has been completed at the University of Virginia Microfabrication Laboratory. This work is being funded in part by the Arizona Radio Observatory of the University of Arizona. The results were presented at the International Symposium on Space Terahertz Technology and will also be presented at the Applied Superconductivity Conference later this year. The design of a balanced mixer incorporating the hybrid has now been completed.
3. This is a joint project of the 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 the 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 restart 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.

Electromagnetic Support Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Design of the EVLA 12–18 GHz feed	09/30/04	09/30/06	
2. Develop dual-frequency 300/800 MHz GBT feed	09/30/05	06/30/06	
3. Measure the EVLA 2–4 GHz prototype feed	06/30/06		06/07/06
4. Design of 84–106 GHz phase shifter	12/31/06		

4. Central Development Lab

Notes:
3. A half-size prototype of the EVLA 2–4 GHz feed was fabricated in the 4–8 GHz band and tested. The feed has an average taper of about -13 dB at the edge of the subreflector. The cross-polarized sidelobes in the 45° plane are below -28 dB and measured return loss is better than -25 dB. The pattern is circularly symmetric over the entire band.

Other Projects:
A study of the beam-pattern properties of a prime-focus array receiver for the GBT was completed. The analysis was done at 1.4 GHz and 2.5 GHz. For a 2.4λ feed offset, the gain loss of the telescope is about 1 dB. A feed array with one feed on axis and six feeds in an outer ring is a possible configuration for a gain loss under 1 dB for the outer feeds. However, these feeds will have an illumination taper of -10 dB at the edge of the subreflector compared to the typical -12 dB taper in a standard single-feed configuration. This means that each of the elements of the array receiver would have slightly more spillover noise than that of the single-feed receiver in addition to having slightly less gain.

Return-loss measurements were carried out on five 1–2 GHz and two 4–8 GHz EVLA production feeds. Return loss is better than -20 dB above 1.03 GHz on the 1–2 GHz feeds and better than -19 dB on the 4–8 GHz feeds.

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-polarizatio, log-periodic on 45-foot telescope, new analog spectrometer	03/31/05	05/15/06	06/16/06
GB/SRBS Phase III:			
2. 10–80 MHz dual-polarization four crossed dipoles, new digital spectrometer	09/30/05	10/31/06	
3. 80–300 MHz dual-polarization log-periodic on 45-foot telescope, new digital spectrometer	09/30/05	09/30/06	
4. 300–2500 MHz dual-polarization 45-foot telescope with log-periodic feed, new digital spectrometer	09/30/05	09/30/06	

The Precision 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. Eight elements array in Western Australia	12/15/06		

4. Central Development Lab

Notes:
4. The proposal to support efforts for the larger array in Western Australia received partial support from the NSF AST Grants Program to build an eight-element array.

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 microwave 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. 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 EPO program. At present, the array consists of four portable sleeved-dipole elements on ground screens that are connected to a central correlator via coaxial cable. The dipoles, active baluns, transmission-line drivers, and receivers were developed by students in 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. An eight-element full-Stokes array in Green Bank was deployed in mid-June 2006. Completion of the 32-element array is scheduled for summer, 2007.

Frequency-Agile Solar Radiotelescope (FASR) Development Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Develop FASR engineering R&D planning document	04/28/06		04/28/06
2. Develop FASR engineering design document	06/16/06	09/15/06	

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

OPERATIONS

5 CHILE

Local Labor Milestones

Milestones	Original Date	Revised Date	Date Completed
1. ALMA Head of HR for Chile hired	01/10/06		01/10/06
2. Local Staff Internal Rules & Regulations as well as Policy and Compensation approved by the ALMA Board Local Labor Working Group	06/20/06		06/20/06
3. Documents above submitted for NSF approval	06/23/06		06/23/06
4. First round of job interviews for engineers and technicians under ALMA Local Labor regulations.	06/19/06		06/23/06

Notes:
1. Will start work at ALMA central offices on July 19.
2. In addition, the ESO council receives copies.
4. Week-long process with representatives from all Executives present. A total of six engineers and three technicians received job offers.

Business/Contracting Milestones

Milestones	Original Date	Revised Date	Date Completed
1. AOS TB Completion Package contract signed	05/26/06		05/26/06
2. ALMA Recreation room dedicated	06/30/06		06/30/06
3. Start Foundations for Vertex and Melco at the OSF	06/08/06		06/08/06
4. Start work on underground facilities for the antenna foundations	06/15/06		06/15/06
5. Start the M3 Road design at the AOS	06/15/06		06/15/06

Notes:
1. With Con-Pax. To be completed March 31, 2007
2. Pool room, projection room, TV, exerciser.
3. A total of five NA and four Japanese foundations.

Other Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Committee for ALMA-CONICYT astronomy fund met and allocated funds to meritorious Chilean science and engineering proposals.	05/26/06		05/26/06
2. Proposal for Chile EPO, as well as Technical and Scientific Collaboration with Chilean Universities, approved by AUI/NRAO.	06/28/06		06/28/06

OPERATIONS

5 CHILE

Notes:

1. With the participation of the JAO, all three Executives, Chilean astronomers, CONICYT, and the Ministry of Foreign Affairs. The total allocated for 2006 was about $500,000.

OPERATIONS

6. e2e

The e2e Operations Division was established on April 3, 2006. Efforts have focused on building the organization, outlining roles and responsibilities, identifying startup funding, building channels of communication, and determining strategies for action in the Division's initial year.

The focal activities during FY07 will be establishing an active presence within the emerging National Virtual Observatory (NVO) facility, ensuring that science products are available for much of the existing archived data from NRAO telescopes, making the archived data easier to access, and making more extensive use of NVO protocols and services. The second priority effort is to bind existing pipeline services to the archive to broaden access. The proposal submission tool will also begin a transition to the e2e Operations Division in the fall of 2006.

These plans are expected to evolve as they grow and are refined over the upcoming months.

e2e Management and Administration Activities

Milestones	Original Date	Revised Date	Date Completed
1. Tactical Plan complete	04/17/06		04/17/06
2. Organization introduced at Visiting Committee, EVLA Advisory Committee and NSF Review, Users Committee	05/17/06		05/17/06
3. Organizational chart developed and approved	06/28/06		06/17/06
4. Plans presented to the AUI Board	06/28/06		06/28/06
5. Conduct meeting with CADC on archive possibilities	07/31/06		
6. Revitalize Observatory Computing Council	07/31/06		
7. Conduct all-NRAO Software Conference	08/10/06		
8. Plans presented at all-NRAO Software Conference	08/08/06		
9. Establish coordinated software calendar for FY07 work	09/30/06		
10. Coordinate efforts of work teams and reporting process	09/30/06		
11. Strategic alliances for external funding established	09/30/06		
12. External funding plan established	09/30/06		
13. Social network analysis early results disseminated	12/31/06		
14. Proposals for external funding developed and issued	12/31/06		

OPERATIONS

6. e2e

NRAO Participation in the National Virtual Observatory (NVO) Project

Milestones	Original Date	Revised Date	Date Completed
1. Initial planning for 3rd annual NVO Summer School	04/15/06		04/25/06
2. Draft SSA 1.0 interface	05/01/06	07/31/06	
3. SIA 1.1 planning for May IVOA workshop	05/12/06		05/16/06
4. Initial draft for spectral-line list interface	05/12/06		05/17/06
5. IVOA interoperability workshop (Victoria BC)	05/15/06		05/15/06
6. NRAO/NVO archive/VO planning meeting held	06/09/06		06/09/06
7. Scalable data-analysis framework prototype	06/12/06		06/12/06
8. NVO/Opticon data-analysis frameworks workshop	06/13/06		06/13/06
9. VOClient software for NVO summer school	07/31/06		
10. DAL service reference code in Java	07/31/06		
11. Draft V1.0 Cone Search specification	08/15/06		
12. Draft V1.0 Simple Image Access specification	08/15/06		
13. Draft V1.0 Simple Line Access specification	08/15/06		
14. NVO Summer School (Aspen)	09/06/06		
15. IVOA interoperability workshop (Moscow)	09/17/06		
16. Conduct Fall 2006 joint meeting of NRAO/NVO	12/31/06		
17. Scalable data-analysis framework functional prototype	02/15/07		

NRAO Archive Infrastructure and Interfaces

Milestones	Original Date	Revised Date	Date Completed
1. Acquire and install ESO/NGAS Archive Software	07/15/06		
2. Install archive host prototype #2	07/01/06		
3. Document physical architecture of existing system	08/30/06		
4. Integrate NGAS archive system into existing NRAO science data archive	09/30/06		
5. Document role of archive facilities in NRAO Integrated Science Center vision	09/30/06		
6. Develop second-generation archive interface prototype based on existing servlets	10/31/06		
7. Updates to SIAP image server	11/15/06		
8. Core Science Group releases new archive interface	12/01/06		
9. Complete transfer of historical VLBA tape archive	12/31/06		

OPERATIONS

6. e2e

Milestones	Original Date	Revised Date	Date Completed
10. Complete transfer of 1.5 Terabytes of historical GBT science data	12/31/06		
11. Construct global calibrator-source database for all NRAO telescopes	5/30/07		

NRAO Proposal Infrastructure & Interfaces

Milestones	Original Date	Revised Date	Date Completed
1. Develop transition plan	09/30/06		
2. Effect transition of NRAO PST and database to e2e Operations	12/31/06		

Scheduling and Metrics Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Establish communications with VLA/VLBA, EVLA, GBT, and ALMA working groups and staff members	08/30/06		
2. Develop coordination calendar for scheduling efforts across the Observatory	12/31/06		

Data Processing (CASA/GBTIDL) Milestones

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

NRAO Pipeline Infrastructure and Interfaces

Milestones	Original Date	Revised Date	Date Completed
1. Select projects for VLA/VLBA pipeline assistance pilot program	05/15/06		05/15/06
2. Schedules generated for all pipeline pilot projects	08/01/06		
3. Pipeline reductions for first 50% of pilot projects complete	07/05/06		
4. Pipeline reductions for remainder complete	08/15/06		
5. Pilot plans for Fall 2006 observing complete	09/01/06		
6. Data Product Generation Plan complete with detailed assignments for new, temporary data analysts	07/31/06		

OPERATIONS

6. e2e

Milestones	Original Date	Revised Date	Date Completed
7. Develop process for augmenting archive with new data products, e.g. images, produced by pipelines	08/15/06		
8. VLA/VLBA calibrator polarization-monitoring pipeline simplified and transitioned to Socorro data analysts for routine population of NRAO archive with relevant images and updates to web interface	08/31/06		
9. Institute coordination between all data analysts	08/10/06		
10. Summary statistics and report on existing VLA/VLBA pipeline in AIPS	09/30/06		
11. Start working through past VLA archive data with AIPS pipelines to generate science products	10/01/06		
12. First half of VLA archive processed via pipeline	06/30/07		
13. Requirements for pipeline improvements set	09/30/07		
14. Second half of VLA archive processed via pipeline	06/30/08		
15. Develop plan for common VLA/Chandra sources	12/31/06		
16. Explore possibility of common NRAO/HST sources	12/31/06		
17. Explore possibility of common NRAO/Spitzer sources	12/31/06		
18. Process in place for a data analyst to pipeline and archive straightforward VLA/VLBA observations within two weeks of data availability	01/31/07		
19. Feedback from researchers regarding utility of pipelined products available and disseminated	06/30/07		

OPERATIONS

7. Computer and Information Services

Observatory-wide Milestones

Milestones	Original Date	Revised Date	Date Completed
1. System administrators meeting in Socorro (b)	04/25/06		04/25/06
2. Begin new CCE coordination for Apple OS/X (b)	04/25/06		04/25/06
3. Upgrade of main web server in Charlottesville (c)	03/31/06	05/31/06	05/31/06
4. Migration to RedHat Enterprise Linux 4 complete at all sites (b)	05/31/06	09/30/06	
5. Upgrade of Google Mini search engine has	05/31/06		05/31/06
6. Deployment of Symantec Anti-virus version 10 (a, b)	07/31/06		
7. Deploy new central Ethernet hub in Green Bank (d)	07/31/06	05/10/06	05/10/06

Notes:
4. This is more than 90% compete. We have uncovered a problem that causes unacceptable slowness of video response on older computers. We will not be able to complete the migration until this is resolved.

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

Charlottesville Computing Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Order computers for summer students	04/15/06		04/15/06
2. Upgrade of central disk filer	04/15/06		04/15/06
3. Migration to RedHat Enterprise Linux 4 complete	05/31/06	09/30/06	
4. Windows administrators at security training (6 days)	06/30/06		06/30/06
5. Order computer upgrades for older desktop computers	07/15/06		

Notes:
3. This is 90% complete.

OPERATIONS

8. Education and Public Outreach

Publications Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Issue submissions call for July Newsletter	05/01/06		05/01/06
2. General public brochure delivered by printer to NRAO	05/26/06	09/11/06	
3. Issue submission call for October Newsletter	09/01/06		
4. 2nd annual AUI / NRAO Image Contest submission deadline	09/01/06		

Notes:
2. This schedule revision driven by the decision to use an external graphic-design contractor.

World Wide Web Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Draft WWW webmaster position description	07/24/06		
2. Draft WWW content-management position description	07/24/06		
3. Draft NRAO WWW concept paper	07/24/06		
4. Confirm FY07 WWW budget availability	09/14/06		
5. Advertise for WWW positions	10/06		

ALMA EPO Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Internal NAASC Ops and Staffing Plan Review	04/11/06		04/11/06
2. Define AUI / NRAO EPO in Chile	06/09/06		06/02/06
3. AUI Board presentation	06/29/06		06/29/06
4. Coordinate FY 07 ALMA EPO program with the NAASC	07/17/06		
5. Organize / coordinate ALMA EPO meeting at IAU meeting	08/23/06		

Notes:
2. Mark Adams traveled to Santiago, Chile May 21–24 to collaborate with Eduardo Hardy on detailed proposals for AUI/NRAO EPO programs in Chile. Adams and Hardy also visited education and exhibits personnel at the Museo Interactivo Mirador in Santiago, which sees 500,000 visitors per year, to discuss the possible introduction of astronomy exhibits funded by AUI/NRAO.

OPERATIONS

8. Education and Public Outreach

Astronomical Community Milestones

Milestones	Original Date	Revised Date	Date Completed
1.. Submit summer AAS meeting exhibition request	04/19/06		04/18/06
2. Summer AAS meeting (Calgary) exhibition ends	06/08/06		06/08/06
3. Ship exhibits and ancillary materials to IAU in Prague	08/01/06		
4. IAU General Assembly (Prague) exhibition	08/14–25/06		

Notes:
4. EPO will operate and staff an NRAO exhibit at the IAU, and is collaborating with ESO and the NAOJ on the ALMA exhibits at the IAU.

Management Milestones

Milestones	Original Date	Revised Date	Date Completed
1. Annual EPO planning meeting	04/27/06		04/27/06
2. Users Committee briefing	05/19/06		05/19/06
3. Draft FY07 EPO Program Plan	06/01–17/06		06/01–17/06
4. Submit draft FY07 EPO Program Plan	07/06/06		
5. Summer Student lecture re EPO	08/03/06		
6. ASP – EPO meeting (Baltimore)	09/16–18/06		

Custom School & Civic Group Program Milestones

Milestones	Original Date
1. Magnificat High School	04/06–07/06
2. Fort Hill High School	04/09–10/06
3. Howard Community College	04-11-06
4. Grosse Pointe North High School	04/17–19/06
5. Glenville State/Fairmont State	04/20-23/06
6. Musselman Middle School	04-24-06
7. Newburgh Free Academy	04/26-28/06
8. St. Paul School	05/01/06
9. Fox Chapel	05/06/06
10. Boy Scout Troup 42	05/06/06
11. Berkeley Springs High School	05/07/06
12.Cross Lanes Christian Academy	05/01/06
13.Girl Scouts of Black Diamond Council	05/13/06
14.Reinhardt College	05/14–20/06
15. Wharton Elementary	05/30/06

OPERATIONS

8. Education and Public Outreach

Milestones	Original Date
16.Oil Region Astronomical Society	06/08–11/06
17. NYSC Staff Training	06/15–19/06
18. 2005 WV Governor's School for Math & Science Reunion	07/07–08/06
19. 2006 VA Governor's School for Math & Science	07/25/06
20. Tygarts Valley Summer Enrichment	08/17/06

Formal Education & Conference Program Milestones

Milestones	Original Date
1. Chautauqua 2006 (Green Bank)	05/30–06/04/06
2. CLEA Workshop	06/15/06
3. SARA Conference	06/17–20/06
4. StarQuest III	06/21–24/06
5. *Quiet Skies* Workshop	06/25–28/06
6. ERIRA	07/08–16/06
7. Chautauqua 2006 (Socorro)	07/12–14/06
8. Goddard Center for Astrobiology	07/14/06
9. NASA/NRAO Joint Institute	07/16–21/06
10. Radio Astronomy for Teachers	07/17–19/06
10. 2006 WV Governor's School for Math & Science	07/30–08/12/06

MANAGEMENT

1. Administration

Environment, Safety, and Security (ES&S)

An updated Risk Analysis procedure and the Safety Manual were posted to the ALMA Safety twiki. Efforts commenced with oversight of ALMA design safety issues. In New Mexico, ES&S continued efforts for recertification of the Array Operations Center halon fire-protection system, and the DOT drug-testing program was drafted. In Green Bank, successful industrial-hygiene efforts included testing the machine-shop chromate solution and a making a full site-wide OSHA compliance inspection. In Charlottesville, the NRAO Safety Committee was formed. Its first meetings are planned for August 2006. Within the next quarter efforts will be put toward an NRAO-wide fire extinguisher inventory and the development of an Arc Flash electrical-safety program.

ALMA

On the ALMA Project, an updated Risk Analysis procedure was posted for presentation to Configuration Control Board. The ALMA SSHE (Safety, Security, Health, and Environment) Policy and Program Manual were posted to the ALMA Safety twiki. ES&S commented on the draft of AUI Internal Rules and Regulations for ALMA new hires. Draft sections for the Safety Manual were prepared for wastewater treatment and other environmental requirements. ES&S worked with the Chajnantor Working Group and implemented new high-altitude medical protocols.

With respect to design safety issues, fire-protection requirements for the Vertex temporary hanger were prepared, and ES&S met with the Vertex antenna design team to review outstanding safety action items. Support was provided on the review of the Nutator Specification and the AOS Internal fiber-splicing team and the Internal Fiber Management Review CDR.

NRAO–New Mexico

In New Mexico, ES&S continued to press for the recertification of the Array Operations Center halon fire-protection system. The items identified as deficient were corrected, and a pressure integrity test is planned for this coming quarter. The potential overcrowding issue at the AOC continues to be examined.

At the VLA, training was provided for the affected employees in the Department of Transportation drug and alcohol testing program for commercial drivers. Also at the VLA site, design efforts commenced toward the proper maintenance and operation of above-ground storage tanks. The Rope Rescue Team is beginning to gain momentum as a new team leader has been selected and there are efforts toward the preparation of Standard Operating Procedures.

NRAO–Green Bank

The Green Bank machine shop uses a solution containing hexavalent chromium, a carcinogen, in the chromate solution. Since there is potential exposure to this agent, industrial-hygiene air sampling was conducted in and around the immediate work area. The sampling protocol complies with NIOSH standards. The sample results indicate that there was no airborne exposure to the agent.

MANAGEMENT

1. Administration

The Green Bank Safety Representative completed an OSHA compliance inspection for the space used for the proposed employee babysitting service and completed a site-wide OSHA compliance inspection in May. Findings were documented and forwarded to the Site Director for resolution.

ES&S conducted a fire-drill evacuation in the Jansky Lab in May. Also, a draft of the proposed NRAO Heavy Equipment Program was prepared.

NRAO–Charlottesville

In Charlottesville, emergency lights, exit signs, and push/pull signs were obtained for the NTC facilities. ES&S is working withfacilities management on the installation of these safety devices. In conjunction with the life-safety upgrades, the NTC Fire Alarm and Surveillance System scope of work was prepared for budget consideration.

Membership for a Charlottesville Safety Committee was determined. This is the first Safety Committee ever convened in Charlottesville. With the increase in ALMA-related activities and the development of the NTC facilities, the committee is planning the first meeting in August 2006. The chief duties of the members are:

- Meet on a quarterly basis and provide minutes to Charlottesville employees and management.
- Conduct a quarterly safety inspection of the facilities.
- Act as "go to" persons for any employee with safety concerns.

The NTC Correlator Fire Protection unit was inspected by Fire Protection Service of Charlottesville. The Fire Protection Service also recharged outdated fire extinguishers and updated the tags.

Future Efforts

In the next quarter, the site safety representatives will develop an inventory of all fire extinguishers, including information on hydrotesting and extinguisher type. Also, the NRAO Arc Flash Program will be developed to better protect employees exposed to high-voltage hazards. Lastly, a program addressing pandemic/epidemic responses will be developed.

2. Program Management Office

Web-Based Business Services (WBBS) Status

The primary focus of the Program Management Office (PMO) over this past quarter has been on the continued development and deployment of the NRAO WBBS, especially the Web Based Business Services Modules review. The review, held in March, covered the currently deployed WBBS services including Procure-to-Pay, Human Resources, Fiscal, Employee Self-Services, and Payroll. Since this review, 68 improvement requests were generated by the user community. Each has been documented as a WBBS Trouble Ticket, and the PMO has been working with the Implementation Team to bring them to successful closure. To date, 40 of the Trouble Tickets have been signed off as completed or closed.

Investigation into other Common off-the-Shelf (COTS) products continued in an effort to address some of the limitations introduced by the current COTS product – PeopleSoft EnterpriseOne. The PMO met with companies such as Paychex, Stromberg, and Qquest to provide alterative solutions that would compensate for some of the PeopleSoft EnterpriseOne products deficiencies.

In this quarter the Electronic Time-Keeping Focus Group continued to develop and mature. Participation rose to 132 members as ALMA began to take part in the effort. Extensive training occurred and policy discussions with management continue.

In June, the PMO installed a hardware firewall to protect the hardware, software, and NRAO corporate data from internal and external security threats. This firewall is the first-ever hardware firewall installed in NRAO and demonstrates the PMO's commitment to protecting the WBBS environment and data.

The following table provides the key milestones that were completed this quarter.

WBBS Services Milestones

Milestones	Date Completed
1. Payroll: Design/bnstruct 3rd party payroll interface	5/12/06
2. Payroll: Ceridian testing and training	5/12/06
3. Payroll: Test plan for 3rd party payroll provider interface (accepted)	5/12/06
4. Architecture Upgrade: Cutover	5/19/06
5. Architecture Upgrade: Technical#4: performance plan (accepted)	5/19/06
6. Architecture Upgrade: Web#2: architecture design (accepted)	5/19/06

MANAGEMENT

3. Personnel

NEW HIRES

Grijalva, Diana	Co-op Student	05/30/06
Sakshaug, Richard	Contract Specialist	04/03/06
Sevilla, David	Intern	06/01/06
Willett, Kyle	Junior Fellow	06/01/06
Williams, Connie	Fiscal Officer	05/22/06

REHIRE

DuPlain, Ronald	Co-op Student	06/19/06
Hill, Jeremy	Research Assistant	05/08/06
Taylor, Gregory	Scientist, Adjunct	06/01/06

TERMINATIONS

Akguner, Ali	Senior Designer	06/02/06
Gao, Yu	Assistant Astronomer, Visiting	04/06/06
Webb, Dale	Business Manager	06/30/06
Wirt, Jr., Donald	Facilities Engineer I	04/30/06
Taylor, Gregory	Adjunct Scientist	06/30/06

PROMOTIONS

Carilli, Christopher	Division Head, NA ALMA Science Center	05/01/06
Fomalont, Edward	Project Scientist, e2e Operations Project	04/01/06
Hibbard, John	Acting Head, NA ALMA Regional Center	05/03/06
Lockman, Felix	GBT Principal Scientist	04/01/06
Maddalena, Ronald	Head, GBT Science Operations	04/17/06
McClendon, John	Technical Specialist II	04/18/06
McKinnon, Mark	EVLA Project Manager	04/01/06
O'Neil, Karen	Head of GBT Program Development	04/17/06
Radziwill, Nicole	Assistant Director, e2e Operations Project	04/01/06
Ransom, Scott	Associate Astronomer	05/01/06
Shelton, Amy	Software Services Division Head, Acting	04/01/06
Welty, Donald	Senior Budget Manager	05/01/06

TRANSFERS

Cheng, Jingquan	Tucson to Charlottesville	05/09/06
Mason, Brian	Green Bank to Charlottesville	06/01/06
Waters, Boyd	EVLA to ALMA	05/01/06

OTHER

Holdaway, Mark	Regular part-time 90% to 60%	05/01/06
Myers, Steven	Six months sabbatical	04/15/06

4. Budget

The table below represents NRAO Operations (without EVLA) expenses and commitments for the first nine months 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, $35,550k in new NSF funds for NRAO Operations has been received. The final increment of new funds is due to be released in early July.

NRAO Operations Expenses and Commitments FY 2006 Year to Date (October 1, 2005 to June 30, 2006)

Work Breakdown Structure Element Level 1	Salaries & Benefits	Materials & Services	Travel	Revenue or Cost Recovery	Total
Observatory Management	$2,556,669	$1,140,795	$241,243	($18,801)	$3,919,907
Education and Public Outreach	$295,951	$142,339	$15,427	($114,175)	$339,543
Central Development Lab	$800,368	$230,281	$14,857		$1,045,506
Green Bank Operations	$5,484,132	$2,154,012	$98,674	($401,024)	$7,335,793
New Mexico Operations	$8,753,762	$3,098,877	$82,292	($83,389)	$11,851,542
ALMA Operations	$476,500	$133,064	$34,730	($6,065)	$638,229
Computer and Information Services	$611,111	$580,299	$20,993		$1,212,404
Division of Science and Academic Affairs	$2,744,957	$354,444	$157,311	($4,975)	$3,251,737
	$21,723,450	$7,834,112	$665,527	($628,429)	$29,594,660

APPENDIX

Acronyms and Abbreviations

Acronyms and Abbreviations

Acronym	Definition
4-band:	74 MHz
AAS	American Astronomical Society
AC	Alternating Current
ACA	ALMA Compact Array
ACS	ALMA Common Software
ACU	Antenna Control Unit
ADIOS	Analog Digital Input Output System
AGN	Active Galactic Nucleus, or Active Galactic Nuclei
AIPS	Astronomical Image Processing System
AIV	Assembly, Integration, and Verification
ALMA	Atacama Large Millimeter Array
AlN	Aluminum Nitride
ANASAC	ALMA North American Scientific Advisory Committee
AOC	Array Operations Center (Socorro, NM)
AOS	Array Operations Site (ALMA)
ARC	ALMA Regional Center
ASAC	ALMA Scientific Advisory Committee
ASP	Astronomical Society of the Pacific
AST	Astronomical Sciences (Division of the NSF)
ATA	Allen Telescope Array
ATI	Advanced Technologies and Instrumentation
AUI	Associated Universities, Incorporated
C-band	4–8 GHz
CADC	Canadian Astonomical Data Center
CASA	Common Astronomy Software Applications
CCE	Common Computing Environment
CDL	Central Development Laboratory (Charlottesville, VA)
CDR	Critical Design Review
CIS	Computer and Information Services
CMB	Cosmic Microwave Background radiation
CO	Carbon Monoxide
COTS	Commons Off-The-Shelf
CONICYT	Comisión Nacional de Investigación Científica y Tecnológica de Chile
CSV	Commissioning and Science Verification
DAL	Data Access Layer (VO interface to science data)
DAT	Digital Audio Tape
DCAF	Data Capture And Format
DOT	Department Of Transportation
DRAO	Dominion Radio Astrophysical Observatory
DSAA	Division of Science and Academic Affairs
DSN	Deep-Space Network (NASA)

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
DTS	Digital Transmission System
e2e	End-to-End
EOD	End-to-end Operations Division
EPO	Education and Public Outreach
ES&S	Environment, Safety, and Security (NRAO)
ESO	European Southern Observatory
EVLA	Expanded Very Large Array
EVN	European VLBI Network
FASR	Frequency-Agile Solar Radiotelescope
FY	Fiscal Year
GaAs	Gallium Arsenide
GB/SRBS	Green Bank Solar Radio Burst Spectrometer
GBT	Green Bank Telescope
GBTIDL	GBT Interactive Data Language
GHz	Gigahertz
GRB	Gamma-Ray Burst
GSFC	Goddard Space Flight Center
GSMS	Governor's School for Mathematics and Science
GUI	Graphical User Interface
HEB	Hot-Electron Bolometer
HEMT	High-Electron-Mobility Transistor
HI	Neutral hydrogen
HLA	High-Level Architecture
HR	Human Resources
HSA	High Sensitivity Array
HST	Hubble Space Telescope
HVAC	Heating, Ventilation, and Air Conditioning
IAU	International Astronomical Union
ICRF	International Celestial Reference Frame
IDL	Interactive Data Language
IF	Intermediate Frequency
InP	Indium Phosphide
IR	Infrared
ISSC	International SKA Steering Committee
IVOA	International Virtual Observatory Alliance
JAO	Joint ALMA Office
K-band	18–26.5 GHz
Ka-band	26.5–40 GHz
Ku-band	12–18 GHz
L-band	1–2 GHz
LNA	Low-Noise Amplifier
LO	Local Oscillator

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
LOC	Local Organizing Committee
LTA	Long-Term Accumulator (GBT spectrometer)
LWA	Long-Wavelength Array
LWDA	Long-Wavelength Development Array
M&C	Monitor and Control
MERLIN	Multi-Element Radio-Linked Interferometer
MHz	Megahertz
MLLN	MIT–Lincoln Labs–NRAO
mm	Millimeter
MMIC	Monolithic Microwave Integrated Circuit
NA	North American / Not Applicable / Not Available
NAASC	North American ALMA Science Center
NAOJ	National Astronomical Observatory of Japan
NASA	National Aeronautics and Space Administration
Nb	Niobium
NbTiN	Niobium Titanium Nitride
NGAS	Next Generation Archive System
NIOSH	National Institute of Occupational Safety and Health
NRAO	National Radio Astronomy Observatory
NRC	National Research Council (Canadian)
NRL	Naval Research Laboratory
NSF	National Science Foundation
NTC	NRAO Technology Center (Charlottesville)
NVO	National Virtual Observatory
OH	Hydroxyl Radical
OMT	Orthomode Transducer
OPS	Operations
OPT	Observation Preparation Tool
OSF	Operations Support Facility
OSHA	Occupational Safety and Health Administration
P-band	327 MHz
PAPER	Precision Aray to Probe the Epoch of Reionization
PC	Personal Computer
PEP	Personnel Evaluation Process
pHEMT	pseudomorphic High-Electron-Mobility Transistor
PMO	Program Management Office
PST	Proposal Submission Tool
PTCS	Precision Telescope Control System
Q-band	40–50 GHz
QSO	Quasi-stellar Object
R&D	Research and Development
RF	Radio Frequency

APPENDIX

Acronyms and Abbreviations

Acronym	Definition
RFI	Radio-Frequency Interference
RTP	Round-Trip Phase
S-band	2–4 GHz
SAO	Smithsonian Astrophysical Observatory
SIA	Simple Image Access
SIAP	Simple Image Access Protocol
SIS	Superconductor–Insulator–Superconductor
SKA	Square Kilometre Array
SOC	Science Organizing Committee
SSA	Simple Spectral Access (NVO term)
SSS	Science Support Systems
submm	submillimeter
TB	Technical Building
TP	Total Power
TRW	TRW Corporation
U-band	12–18 GHz
UC	Users Committee or University of California
UNM	University of New Mexico
UVa	University of Virginia
UVML	University of Virginia Microfabrication Laboratory
VC	Visiting Committee
VLA	Very Large Array
VLBA	Very Long Baseline Array
VLBI	Very Long Baseline Interferometry
VO	Virtual Observatory
VSOP	VLBI Space Observatory Program
VSOP-2	VSOP successor
VSWR	Voltage Standing-Wave Ratio
WBBS	Web-Based Business Services
WBS	Work Breakdown Structure
WIDAR	Wideband Digital Interferometric Architecture (EVLA correlator)
WWW	World-Wide Web
X-band	8–12 GHz

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 from April—June 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 July 2006, in which case this will move into the autumn.
- **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 Foundation and Shell Packages have been completed on schedule. The Completion Package construction work is ongoing 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 was released and responses received in April, 2006. The design work will continue with M3 Engineering, to be finished in Q1, 2007. Road construction will now start in Q3, 2007 following ESO who will build the antenna foundations.

  The power distribution design should be finished also in Q1, 2007 and construction is scheduled now for Q3, 2008.

- **Complete procurement of AOS Technical Building outfitting material by March 2006:** Bids were opened in March 2006. Purchasing is substantially complete.

- **Complete ALMA–supplied site work at the Vertex site-erection facility by April 2006:** The site grading has been completed, as also the antenna foundations. Utilities (water, sewage, electrical and fiber optics conduits installations are also finished).

Antenna IPT Objectives:

- **Hold the Antenna Preliminary Pre-Production Design Review in January 2006:** Scheduled for February 9th and 10th, 2006. The meeting was delayed three 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 is extremely difficult and Vertex has spent significant effort working with this vendor to get under contract. The Pre-Production Design review (P2DR) is expected to be ~two 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.

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 30 October 2006. The delay can be attributed to difficulty by the vendor in meeting the tight specifications for the IF Switch, the additional work required by Back End to design the fiber optic LO reference distribution cables for adequate phase stability, prototype board fabrication, and Thermal Design Review of the Chassis.

- **Freeze the hardware design of the monitor and control circuit in February 2006:** This activity is currently scheduled to complete on 29 September 2006. Although this appears to be ~ seven months past due, a re-planning effort shifted the target completion of this milestone. The true delay is attributed to design delays for Cryostat M&C for incorporation of safety features (gate valve) and procurement delays in the CPDS & IF M&C modules.

- **Make the NA Front End Integration Center operational in April 2006:** This activity is currently scheduled to complete on 27 October 2006, with the proviso that initial measurements will use

harmonic mixers to lock the LO until the optical signal generator needed for simulating the ALMA LO reference is delivered in April 2007. The primary reason for the 6-month delay is late vendor delivery of the beam scanner; the integration center has been used for limited testing since June 2006.

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 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. 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 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 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 can be done at any time, but has been postponed to allow software development to continue smoothly and thermal tests to be completed. Once ready for shipping, this 1st Quadrant may go into storage until it can be received at the OSF and installed in the AOS TB. This, in turn, will allow space for the 3rd Quadrant to be assembled & tested. It is possible to delay this activity for a few more months while much of the 3rd Quadrant assembly is done in the correlator lab.

- **Ship test fixtures to Chile in June 2006:** This activity can be done at any time. However, until 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 can be done at any time, but it has been postponed pending completion of thermal tests on the Station Racks. This will be followed by installation and integrated testing of already-tested boards, DRX cards and TFB cards.

- **Begin integration of the third correlator quadrant in July 2006:** The phrase "begin integration" implies all hardware has been procured (complete) and that assembly has started (still on target for July of 2006). As with previous milestones, this is on target to meet schedule.

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 was completed in mid-April, about 6 weeks earlier than scheduled. The integration went much more efficiently for this release than previous ones because of the software stability initiative, and because of the extensive testing in support of the optical pointing tests.

- **Support first fringes at the ATF in June 2006:** This objective has not yet been achieved, and is now likely to occur beforeQ4 2006. In general lab testing has gone more slowly than anticipated. The principal computing issue is that full fringe tracking and delay support is not fully implemented and tested.

- **Hold an incremental CDR in June 2006:** This was completed in late June.

Systems Engineering & Integration IPT Objectives:

- **Begin detailed planning of antenna AIV (assembly, integration, and verification) in Chile in January 2006:** On track (this is a JAO Project Engineer deliverable).

- **Install full electronic system and control software on ATF antennas in January 2006:** Running approximately nine months late owing to late delivery of hardware and software to PSI and difficulty in achieving reliable system connectivity and system stability. The relative phase of timing signals in the low frequency LO is the leading problem that needs to be resolved.

- O**btain first fringes at the ATF by June 2006:** Running late owing to the delayed move of prototype hardware and software to ATF.

- **ICDs for baseline and Enhanced ALMA substantially complete by July 2006**: On track.

- **Release system performance budget document in March 2006:** Performance budget was developed; actual performance data is being added (this is now a European deliverable).

ALMA CONSTRUCTION

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:** The contractor for the design for the road and fiber network on the site delivered his strawman plan in September 2006. Holdaway has produced a mask to constrain antenna locations to be near the strawman plan roads. He is currently working on suggestions to the contractor, M3, so that a reasonable beamshape is obtained. When this iteration completes, the chosen locations on the site will be examined for suitability and the final tweak achieved. This is expected to occur by December 2006.

Atacama Large Millimeter Array

Quarterly Report for the period

April-June 2006

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

1 Management IPT

1.1 European Project Office

1.1.1 Overview

The ALMA Project has made substantial progress and passed several important milestones during the last months.

A major accomplishment for the ALMA Project was ESO Finance Committee's approval to negotiate and conclude a contract for the OSF with the preferred bidder, following a competitive tendering. This decision allows the ESO Management to proceed with an important deliverable, which had been initiated a few years ago and which had undergone several revisions due to change of scope.

Important progress has been made in reaching approval to sign amendments to the bilateral agreement and the agreement between ESO, NSF, and NINS (National Institutes of Natural Sciences, Japan). These agreements, among others, formalize the Japanese participation in ALMA, thus becoming a project of three partners.

An updated study of the permanent power supply for ALMA has been received and is under analysis. Recent changes of energy supply in Northern Chile, beyond the influence of ALMA, may require a significant change in the conceptual layout of supply, as defined in the rebaselined ALMA.

Significant technical progress on the Local Oscillators, provided by NRAO, has been confirmed by NOVA, being in charge of the Band 9 cartridges. The performance of the Local Oscillators has been a matter of concern. However, with new developments so encouraging, it is expected that the development and pre-production of the Band 9 cartridges will be concluded with acceptable performance.

ESO-ALMA Management is concentrating on several important procurement contracts concerning Front End and Back End equipment. These are to be placed with European institutions who have been involved in the development and pre-production.

1.1.2 Personnel

Paola Andreani was selected as the ALMA Regional Center (ARC) Manager and took up her position in the DMO Division on 1 June 2006.

The vacancy for the Front End Production Engineer was announced and numerous applications were received. Several interviews were held, but no suitable candidate was found. The vacancy for the Front End Production Engineer was re-announced and several applications were received. Candidates have been selected for interviews to be held in early July.

1.1.3 Santiago Offices

According to the sharing of responsibilities and work packages, ESO shall provide the ALMA office building in Santiago. The baseline plan is to construct a new building on the ESO premises in Vitacura. The site has been identified and initial work has started. The ESO Finance Committee received advance information on the Call for Tenders for Design & Engineering Services and the Construction of the ALMA Central Office Building in Santiago. Just recently, ALMA Management received information that three floors, adequate to fulfill ALMA's space requirements, could be purchased in a new building, soon to be constructed adjacent to the ESO premises in Vitacura. ALMA is studying this alternative.

1.1.4 Contract Activities

Many contract activities have progressed in the various ALMA IPTs. They are discussed in detail in the corresponding sections of this report. In this section, only the major ones are discussed.

The procurement contract for 25 antennas was signed 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 on site in Chile of 25 ALMA Antennas with the option to purchase additional antennas, up to a total of 32. The completion of the provisional acceptance of the first antenna is scheduled for 21 September 2008. The provisional acceptance of the 25th antenna shall be completed by 6 December 2011, i.e., exactly 72 months after contract signature. Besides the day to day interaction with the AEM Consortium, several monthly technical progress meetings (face to face) were held. 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. During the reporting period, ALMA discussed with the Consortium the possible change of the subreflector tilt mechanism. It was determined that a modified mechanism can increase the efficiency for certain frequency bands as much as 3%. This is a significant improvement, which needed serious discussions within ALMA. Concern was raised by the AIPT Leader about the long period of time the process has required to come to a clear position towards the Contractor. The AIPT Leader and the AIPT team are closely monitoring the progress in numerous areas, including, but not limited to, technical and managerial aspects, as well as potential geographical return within ESO Member States.

During the first months of the procurement contract for the two Antenna transporters, the contractor, Scheuerle Fahrzeugfabrik GmbH, informed ESO that the originally foreseen tires for the transporters face extremely long delivery times. Such delays would subsequently delay the delivery of the first transporter by several months. The Contractor offered ESO an alternative design via Change Request, using more and smaller tires, which are readily available on the market. ALMA has carefully studied the implications of this Change Request, and they have been accepted. The procedure to accept this Change Request has caused a delay of the delivery of the first transporter of about two months. The accepted change has no implications to cost and schedule beyond the delay mentioned above.

A second call for tenders had to be issued for the Technical Facilities at the Operation Support Facility (OSF) and 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 was made to the ESO Finance Committee at its session on 9/10 May 2006. 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 have 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 budget. The proposed procurement was presented to the ALMA Budget Committee on 12 June 2006. The ALMA Director recommended to the ALMA Board to concur with the proposed procurement, which the Board did at its June meeting in Santiago. After contract approval, remaining technical, commercial, and legal aspects were addressed in further negotiations with the bidder. In view of the complexity of the project and the magnitude of the financial commitments to be taken on by ESO, the contract negotiations required an extension of the original validity of the offer, expiring by 30 June 2006. An extension of the offer, without changing the fundamental conditions outlined therein, was granted by the bidder until 31 July 2006.

An update of the feasibility study for the design of the Power Generation and Transmission Systems has been delivered by Lahmeyer International, Germany. As one result of this study, ALMA cannot be certain of the gas supply for a dual-island mode power station at the OSF; up to then 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 are 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 Subsystems with experienced and qualified institutions in ESO Members States. The contractual amounts of all these contracts are estimated at 14.7 MEUR. The Finance Committee was informed that most of the contracts have been completed or are close to completion within the contractual price and within the revised schedule. Some modest cost overruns have occurred due to changes of scope of the work packages.

The Finance Committee has approved to amend the development and pre-production contract for the Band 9 Cartridges, which was necessary due to delays and additional costs beyond the responsibility of the Contractor, NOVA. The amendment is in preparation and expected to be signed in August 2006.

Following FC approval and the successful completion of the PDR for the TFB cards, a Request for Proposal was submitted by ESO to the University of Bordeaux for the production contract. The proposal has been received. The procurement contract is expected to be placed in July.

1.1.5 Recent ALMA-related Meetings

1.1.5.1 ESO Finance Committee

The 114th Finance Committee meeting was held in Garching on 9/10 May 2006. The Head of the ALMA Division gave a project status report.

The Head of the ALMA Division also presented a request for approval to negotiate and conclude a contract for the “Civil, Structural, Architectural, Mechanical and Electrical Work and Equipment at the Operation Support Facilities (OSF) Site of the ALMA Observatory in Chile” with the proposed supplier. The Finance Committee approved this request.

The Finance Committee approved:

- the amendment of the development and pre-production contract for Band 9 cartridges, placed with NOVA, and
- the amendment of the contract for fuel supply of ALMA.

A document reviewing the status of prototyping and pre-production contracts and procurement for production for ALMA Front End, Back End, and Correlator Sub-Systems was presented. The Finance Committee did not approve the proposal, in particular with respect to the procedures related to the production contracts. ESO shall clarify certain critical issues with the institutions involved in the development and pre-production and present this matter again.

1.1.5.2 ESO Council

The 108th Council meeting was held in Garching on 6/7 June 2006. The ESO Director General reported about ALMA progress in her general presentation of ESO.

The Council:

- took note of the ALMA Biannual Progress Report, April 2006,
- took note of information provided on the possibility to purchase space for ALMA offices in a building, to be constructed soon, adjacent to the ESO Vitacura offices,
- took note of the Council President's report from the ALMA Board,
- disbanded the European ALMA Board with immediate effect,
- authorized the Director General to sign the Amendment #1 to the ALMA Bilateral Agreement concerning Local Staff in Chile and the AUI-ESO Management Agreement,
- authorized the Director General to sign the Amendment #2 to the ALMA Bilateral Agreement, and
- authorized the Director General to sign the Amendment #2 to the ESO-NSF-NINS Agreement.

1.1.5.3 ALMA Board

The 11th ALMA Board meeting was held in Santiago on 13/14 June 2006. Among many matters discussed at the meeting, the ALMA Board concurred with the ALMA Director's recommendation that ESO proceed with the placement of the OSF construction contract.

1.1.5.4 European Project Office Boards and Committees

The European Project Office continued to organize and support various teleconferences, videoconferences, and face to face meetings of ALMA Boards and Committees. The following events were held during the reporting period:

- ALMA Board 24 May – teleconference
  13/14 June – face to face meeting in Santiago
- ASAC 3 May – teleconference
- ESAC 3 May – teleconference
  21 June 21 – teleconference

With the ESO Council decision to disband the European ALMA Board, no further Board meetings will be held.

1.1.6 Technical and Managerial Concerns

Site

- The general concerns about the cost-of-construction developments in Northern Chile remain.
- There are serious indications that gas cannot be supplied to the ALMA site. The alternative to the baseline solution (a dual-fuel island mode power supply station) is the y direct supply of energy from Chilean electricity suppliers, which may turn out to be significantly more expensive.

Antenna

- The resources in the Antenna IPT are limited with respect to the tasks required by the project. The existence of two (three with NAOJ) parallel contracts for the antennas gives rise to additional work compared to the originall planning. Similarly, the maintenance and upgrade of the interfaces between the Antenna IPT and other IPTs (BE, FE, Site) is becoming a non negligible task.
- On site presence in operating the AEC prototype is adding to the work load. Interventions have to be performed regularly, including those in support of the Software group and Prototype System Integration.
- The response time and the actual procedures in the ALMA Organization for handling change requests (from either ALMA or from the Contractors) are not sufficiently efficient. Difficulties became obvious to:
    - a) prepare necessary changes/updates to the specifications and,
    - b) react within the time agreed in the contracts (usually 3 weeks) to Change Proposal coming from the Contractor.

  Impacts on the schedule are very likely if the procedures are not more efficient and expeditious in the future.

Front End

- The major concern at this point in time is getting agreement on the procurement and contracting strategy for the European FE production work packages. While this issue is currently not resolved, the first pre-production contracts for cryostats, etc., have to be concluded within a few months. The placing of production contracts is prevented at this time.. As a result, delays in delivery of complete Front End assemblies are likely. In order to resolve this issue, intensive discussions and meetings, both ESO internally as well as with the involved institutes, are ongoing.
- Place contract for design & prototyping of FE robotic arms. This task is on the, local, critical path for delivering the first two calibration devices to the project.
- Timely procurement and delivery of a LORTM for the EU FEIC.
- Obtain contract for the operation of the EU FEIC in place. This is linked to the general concern of placing ALMA production contracts by ESO with institutes.
- To receive the necessary engineering documentation from NRAO to assemble and verify the FE assemblies.

Back End

- Some of the proposed modifications to the Digitizer Assembly are rather substantial and would result in a new product needing development and test effort. The intention is to keep the effort and the risk as low as possible, limiting it to the absolutely necessary modifications.
- Some faulty Digitizer chips were found. This problem is under investigation. No clear indications have been received from the Manufacturer.
- The procurement for additional components for ACA shall be concluded within September due to the expiration of the availability of chips.

Correlator

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

Manpower

- Hiring Local and International Staff remains an important matter

1.2 North American Project Office

1.2.1 Overview

- Following the North American Cost Management Review last quarter, a further review was held in April – the ALMA NA Contingency Review. This review, which comprised a subset of the original cost review, looked at the proposed parametric cuts to the NA ALMA budget and their impact on the overall level of contingency available in North America. They endorsed the proposed parametric cuts and recommended additional funding to bring the total contingency up to 25% of the uncommitted budget. Further, they endorsed planning for contingency to allow for an additional year at the end of the project.
- In May, the NSB approved the new baseline, including a one-year extension to the original schedule. Based on the recommendation of the contingency review, NSF has now budgeted a total of $491.9M (Then-year Dollars) for the ALMA project – an increase of $147.5M (Then-year Dollars).
- Negotiations continue to facilitate the entry of Taiwan into the NA ALMA program with a goal of agreements being in place by the end of the year. In Taiwan, ASIAA submitted their proposal to the NSC in April. This activity was supported by North America.
- Work has largely concluded to allow AUI to hire the ALMA Local Staff in Chile. The AUI Implementation Plan was approved by ALMA Board on 24 March. .The amendment to the ALMA Agreement designating AUI as the employer of Local Staff for the Bilateral Project was approved by ESO Council on 6 June and signed by the ESO Director General on 14 June. NSF approval is anticipated in early July. Once this is in place, the AUI/ESO Management Agreement will be signed. This,*inter alia* designates the NRAO Director as responsible for Local Staff matters; formally establishes the "Director's Council" consisting of the NRAO Director, the ESO Director General, and the ALMA Director; and enables sharing of procurement information between AUI and ESO.

1.2.2 Personnel

- Drew Medlin joined the SE&I IPT in June.
- Richard Lacasse relocated from Green Bank to Charlottesville and joined the Correlator IPT in June.

1.2.3 Contract Activities

- In the review period, the following contracts over $250k were approved by the NSF:
  - AOS-Technical Building Completion Package: $3,683,471
  - IF Downconverter Pre-Production Units: $348,576
  - AOS-TB HVAC: $684,286
  - OSF Antenna Foundations: $457,108

1.2.4 Technical & Managerial Concerns

- The biggest Managerial concern for North America, securing the necessary resources to complete the project, has been largely resolved by the NSB reapproval of the ALMA project. Of course, Congress must approve the ALMA budget on an annual basis.
- Vertex formally announced a delay in delivery of Antenna #1 of 10 (+/- 2) weeks. This was due to the delay in the delivery of the main azimuth bearing. The Azimuth bearing manufacturer was reluctant to commit to verification of the extremely stringent wobble specification. There has been no change to delivery dates for Antennas # 2 – 25. The situation is being monitored very closely, and an NRAO Antenna IPT representative is on-site at VA facilities in Duisburg for one week in every three weeks. To ensure that we do not cause any delay, response to Vertex Action Items is given absolute top priority by

the NA Antenna IPT; the goal is to respond ASAP to Vertex action items regardless of response date required indicated by Vertex. Furthermore, clear and unequivocal direction has been given to Vertex that, unless explicitly directed to, they should not delay their design if they raise concerns about ALMA design choices or assumptions.

2 Site IPT

2.1 Status

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

In the decision of the value balancing, EU will deliver all Antenna Stations at the AOS. The Statement of Work and the Technical Specifications have been prepared and are currently under review. The documents are based on the EIE design with the possibility of using the alternative Fichtner design where soil conditions are found appropriate.

2.1.2 Technical Building at the AOS (NRAO)

Construction of the AOS Technical Building Foundation and Shell Packages were completed in April 2006; provisional acceptance and final acceptance have been granted. The Completion Package was awarded to the same Contractor on 18 April 18 2006, to be completed in April 2007. During this past quarter, the Contractor has prepared the building schedule and purchased the materials for the interior finishes. Work is to start in mid August, when the worst of the winter is over.

Meanwhile, the NA Site IPT has purchased all the equipment to be installed inside the building by the Contractor, which includes HVAC systems, fire detection and extinguishing systems, the oxygen enrichment system, etc.

AOS Technical Building Foundation and Shell Packages

2.1.3 Permanent Access Road (ESO)

In March 2006, the 43 kilometers of the modified road formation level of the access road from the Chilean highway CH23 via the OSF to the AOS have been completed. Road maintenance

works are ongoing. Adjustment of slopes and construction of drainage trenches will be completed during 2006. The road pavements will be contracted at a later date (2007-2008).

Final Road Layout

2.1.4 Technical Facilities at the OSF (ESO)

The ESO Finance Committee approved the proposed OSF contract during its session in May. Subsequently, final contract clarifications were held and are ongoing. The contracting could thus 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 has been awarded to Lahmeyer International (LI), Germany. The updated Power Generation Study indicated that a connection to the public supply network was most advisable. At the March 2006 ALMA Board meeting in Japan, it was decided to follow this recommendation. The Statement of Work of Lahmeyer to reflect the changed scope of Work was prepared. An amendment to the contract of LI will follow.

OSF Site with mark of an Antenna Foundation

2.1.6 ALMA OSF to AOS Fiber Optic Link (ESO)

During this reporting period, the matter was not further followed, pending the finalization of the power generation, which is still under progress. There are no outstanding concerns at this time.

2.1.7 Environmental Aspects

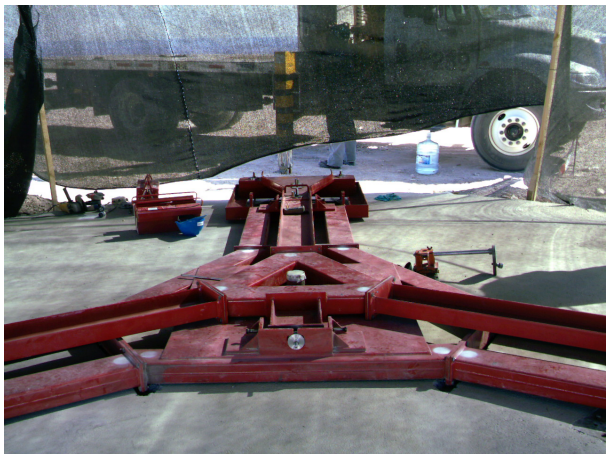
Road construction works were completed in March 2006, and a new survey of the vizcacha colonies was done in April and May. Positive results indicate that after road construction ended,,the vizcacha count has increased.

2.1.8 Configuration Review

The layout of antenna foundation locations at the AOS area was further analyzed. Apparent discrepancies between the aereophotograpic survey and actual UTM locations were checked and the confirmation of locations within the 5 Km array was achieved. The configuration of the antenna foundation locations of the outer array will be established working with the AOS road designer in Q4, 2006.

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 contract of these areas is substantially complete; only the Melco pads insert installation within the foundations is still missing. The work will be finished by mid August 2006. The Contractor's area utilities installation will also be finished by mid August 2006.



Installation of steel inserts in a Vertex SEF antenna foundation.

Utilities (water, sewage, electric and FO conduits) for Vertex/Melco/AEM antenna contractors SEF areas.

2.1.10 Culverts and Drainage Structures (ESO)

The construction of the culverts and drainage structure at the canyon crossing at Km 6.9 was completed. Documentation for all remaining culverts has been approved by an extraordinary Finance Committee meeting in March 2006. The tender documents are currently being prepared. Completion of all remaining culverts is scheduled in mid 2007.

2.2 Concerns and High Level Risks:

- The late start of Antenna Foundations at the AOS site, due to the decision on value balancing between EU and NA, could cause delays.
- Fiber Optics design by Back End and Computer groups.
- Late start of the Permanent Power Supply operation due to the necessary evaluation of the Power Study.

2.3 Next Period Goals:

(NRAO)

- Continue construction work on the interior finishes and electro-mechanical installations of the AOS Technical Building.
- Bid the ALMA and Contractors Camps enlargements.
- Design of AOS road and utilities, to be finished in Q1 2007.
- Finish building the antenna foundations within the Antenna Contractor's areas.
- Finish utilities installation in the Antenna Contractors SEF areas.
- Purchase and install the temporary power supply extension.

(ESO)

- 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.
- Start construction of the AIV Temporary Building.
- Start construction of the Holography Tower.
- Start construction of the Sewage Treatment Plant extension.
- Complete Tender action for the construction of the road intersection with Chilean road CH23.
- Complete the tender documentation for the AOS Antenna Stations.

3 Antenna IPT

3.1 Status

3.1.1 Production Antenna Procurements

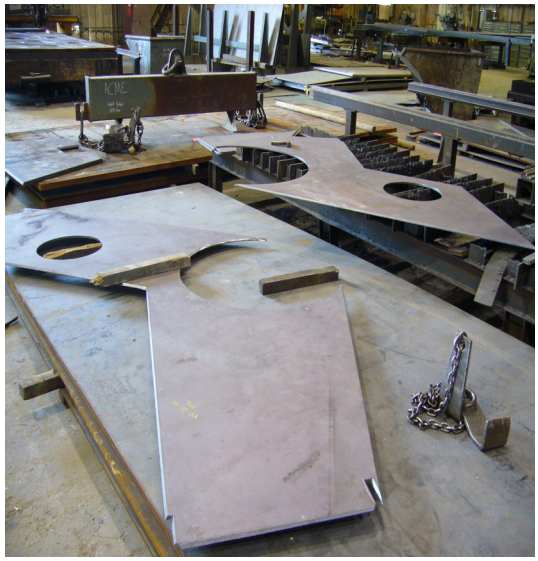
3.1.1.1 NA Antennas

- All long lead item contracts have been awarded and fabrication is underway.
- Manufacturing drawings are complete and were released for production of Yoke, Receiver Cabin, Invar Cone, and Support Cone.
- Steel has been cut for the pedestal components and is being tack welded and shaped for final welding.

Invar Cone

1/3 of Support Cone Base

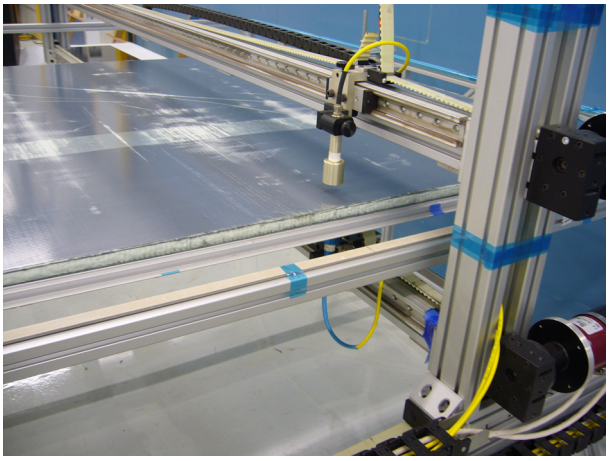
Yoke Arm Component



Yoke Arm Components

- Manufacturing processes and fabrication techniques have been investigated and optimized for the CFRP Backup Structure. CTE and 3-point bending tests have been completed and physical measurement data fed back into finite element model.

Prototype CFRP BUS Segment showing invasive quality inspection cut-outs



Ultrasonic quality inspections of CFRP sandwich structure

- Manufacturing of aluminum reflector panels is well underway and on schedule.
- Static, Thermal, and Seismic finite element model analyses are complete and results are being checked and verified.
- Erection of the ALMA Antenna Integration Facility in Kilgore, Texas, is well-underway and scheduled for completion next quarter. The pedestal components (support cone, receiver cabin, yoke, Az & El bearings, Invar cone, gearboxes, UPS, HVAC, etc.) will be assembled and shipped as a single assembly to Chile.

VertexRSI ALMA Antenna Integration Facility

- Additional testing of metrology system was performed on prototype antenna at ATF with support of NRAO. In addition, FE analyses were performed to compare with physical measurements.
- Antenna Control Unit (ACU) software design is complete and detailed coding is underway. Migration of low-level board drivers from VXWorks to RTAI Linux is complete including test verification.
- Three ACUs have been procured and are in-house to support detailed software coding development.
- Planning and preparation have started for the upcoming Pre-Production Design Review (P2DR).

3.1.1.2 European Antennas

- The design is proceeding within schedule. Five progress meetings were held with the AEM Consortium through the end of June.
- The design has evolved in many areas from the original design based on the AEC prototype at Socorro. One of the most visible changes is the pedestal which is now compatible with the three-point interface to the antenna station. Other important conceptual changes are the modification of the quadripod, now based on 4 CFRP single legs, the relocation of the azimuth motor outside the pedestal enclosure, the change of the azimuth encoder to a strip encoder, and the use of a three-roller azimuth bearing.
- Additional changes were made in other areas to optimize the manufacturing and assembly process. In various cases, the manufacturing experience of potential suppliers was used as input to the industrialization of the baseline design. An example is the CFRP cabin, now based on three sub-assemblies (versus nine in the prototype) for ease of production, in order to guarantee the delivery schedule during serial production. Similarly, the steel structure of the elevation drives has been greatly simplified in order to expedite the assembly and alignment on site.
- In parallel, all the system analyses where performed to the level sufficient to justify the issuing of the call for tender for the manufacturing of the subassemblies. In particular, the Finite Element model was updated and it is one to one with the design. The global analysis demanded by the Statement of Work is completed and the error budget is available. Input to the FE analysis on the basis of the error budget were obtained by detailed thermal analyses and computational fluid analysis.
- A CRE has been requested from AEM to provide tilt capability for the subreflector.
- The system engineering tasks are in progress, with the allocation of the reliability budget, the preliminary hazard analysis, and first investigations on the effect of high altitude.
- The AEM Consortium has performed a mission at Socorro to acquire data on the metrology system of the prototype. Valuable information has been collected and is being used in the finalization of the metrology system.
- Qualification tests of CFRP resin were performed. Further qualifications are planned in various areas, including the subreflector mechanism, azimuth motors, and feed shutter.
- The procurement process of the various subsystems has started. In almost all areas, offers were received and negotiated with industrial suppliers. The Consortium is close to signing contracts for the manufacturing of many parts of the antenna including CFRP cabin BUS and panels, which are on the critical path. (The supplier of the steel structure is not yet defined).
- The design of the on-site Work Area has been finalized, following a meeting on site with representatives of the AEM Consortium and of their supplier in Chile, MAN-DSD with whom a contract has been signed for the final preparation of the Work Area and erection of the antennas.
- The schedule is unchanged. The Pre-Production Design Review is planned for December 2006.

3.1.2 Vertex Prototype Antenna (NRAO)

- The Vertex Prototype Antenna is being heavily used by PSI and Computing IPT.
- Supporting PSI activities through fault resolution and maintenance, as well as personnel training.
- Software upgrade to antenna control unit was requested by Computing IPT and has been performed by Vertex.
- Designed, fabricated, and will install a torque tube to allow for installation of LO subsystem fiber cable through the azimuth and elevation axes in support of PSI.

3.1.3 AEC Prototype Antenna (ESO)

- A test campaign on the AEC prototype metrology system was performed by AEM in the spring.
- The AEC prototype antenna is now being used by PSI and Computing IPT.
- Supporting PSI activities through fault resolution and maintenance. Formal training of ALMA personnel is envisaged to start in October 2006.
- ALMA software-specific modules upgrade (to be? has been?) tested on the antenna.
- In the next period, a dedicated torque tube will be installed to allow for installation of LO subsystem fiber cable through the azimuth and elevation axes in support of PSI.

3.1.4 Transporters (ESO)

- Various technical and progress meetings were held at Scheuerle, the producer of the transporters. The design has advanced to a PDR level.
- The Contractor had to generate a design concept different from their original design proposal, because tires used in the proposal could not be purchased within the ALMA schedule. This design change has an impact on the ICD between Transporter and site.
- A Change request to cover the new design has been submitted by Scheuerle. It has been reviewed by ALMA and an agreement was found.
- At the end of June, the Contractor was involved in the preparation of the Preliminary Design Data Package for the PDR scheduled for the end of July. Most of the subsystems (propulsion,, steering, cabin, brakes, etc.) are at an advanced state of the design. No technical problems could be identified to possibly affect the PDR.
- The Contractor has started procurement of long-lead items, prior to the completion of the design phase, due to the rising delay announced by the suppliers as a consequence of the growing economy.
- The long delay in resolving the problem related to the ICD with the site has affected the freezing of the design. The first transporter will be delivered approximately seven weeks later than originally foreseen.

3.1.5 Nutator and Optical Pointing Telescope (NRAO)

- The Nutator Technical Specification and Statement of Work were completed and submitted to four companies for bid. Bid responses are due to NRAO on 5 July 2006.
- A draft version of the Optical Pointing Telescope (OPT) was developed and distributed to two companies for evaluation of opportunities to use existing commercial products with minimal customization.

3.1.6 Antenna Stations Foundation design (ESO)

- The design of the tooling for the foundation alignment was completed. Procurement of two sets started, one in Europe by the AIPT, and the other in Chile by the Site IPT.
- Procurement of a first batch of interface parts has started to serve the Work Area foundations of the three Antenna Contractors.

3.2 Technical and Managerial Risks and Concerns

- The complicated decision process within ALMA, regarding technical issues, technical changes, and interface issues, causes serious difficulties in the interaction with the industrial suppliers. It has proven very difficult to keep stable the interfaces with other IPTs and to give timely responses to queries coming from the antenna Contractors.

3.3 Tasks during Next Quarter

3.3.1 Production Antenna Procurements

NA Antennas

- Execute Vertex Pre-Production Design Review
- Continue manufacturing

European Antennas

- Continue the design process with the finalization of the system tasks.
- Conclude the contracts with the major suppliers and complete the detail design phase.

3.3.2 Antenna Transporter

- Perform the PDR of the Transporter and advance the design to the FDR level.

3.3.3 Others

- Continue activities related to the Nutators and the Optical Pointing Telescope.
- Continue work in maintaining the Interface with BE and FE
- Support the PSI activities at Socorro.

3.4 Progress on Milestones for Last Period

- No major milestones defined for this period.

4 Front End IPT

This report covers the period April-June 2006.

4.1 Planned vs. Actual Accomplishments (ESO and NRAO)

Major accomplishments planned for this period and the *status of these activities:*

(1) Complete cryostats 1-5 / *done*.
(2) Complete design concept for amplitude calibration device / *done*.
(3) Complete acceptance documentation for Band 3 cartridges / *almost completed, awaiting final management signatures.*
(4) Identify causes of Band 6 mixer infant mortality and prevent reoccurrence / *done*.
(5) Complete testing of Band 6 cartridge #1 / *almost completed, awaiting gain compression tests.*
(6) Perform vibration test on Band 6 prototype cartridge / *done*.
(7) Deliver Band 7 cartridge #1 to the NA FEIC / *done*.
(8) Demonstrate a revised LO system for Band 9 which provides sufficient power / *done; an X9 multiplier plan is adopted*.
(9) Perform vibration test on LO WCA / *done*.
(10) Continue design and prototyping of Front End assembly / *ongoing activity, almost done.*
(11) Design improved DC Bias subassembly / *not completed, but parts of design well advanced; several more performance issues were identified and will be examined.*
(12) Install and commission FEIC environmental chamber and install existing test equipment / *completed. Except for the beam scanner and LORTM, the equipment is completed.*
(13) Agree on design and procurement plan of LORTM / *not completed; design concept agreed, procurement plan nearly done.*
(14) Continue evaluation of WVRs – door / *ongoing activity.*

4.2 Status and activities

4.2.1 FE IPT Management (ESO and NRAO)

Substantial effort has been put into assisting ESO management to prepare for the FE production contracts. Putting these production contracts in place is becoming urgent since some of the current pre-production contracts will be completed soon.

In a second round of advertising by ESO, more suitable candidates for the position of FE Production Engineer have been found. A short list of candidates to be interviewed has been prepared.

4.2.2 General (ESO and NRAO)

An early prototype model Band 6 mixer-preamp, not mechanically compatible with the Band 6 cartridges, was sent on loan to the University of Arizona and incorporated into a receiver mounted on the Sub-Millimeter Telescope (SMT) for testing on the sky. A report to be released as ALMA Memo 553 shows that the noise performance exceeds that of the existing SMT receiver by a large factor, giving a SSB system temperature as low as 107K at the zenith and improving sensitivity by a factor of 3 in required observing time.

4.2.3 Cryostat (RAL)

Acceptance of cryostats #3 and 4 took place during this reporting period. Assembly and verification of cryostats #5 and 6 were completed. The vessels for cryostats #7 and 8 were manufactured by a sub-contractor to RAL. However, due to severe mechanical tolerance problems these had to be rejected. Several cartridge bodies were delivered to the various cartridge groups. The Band 4 and 8 cartridge body designs proposed by NAOJ were reviewed.

4.2.4 Optics / Widgets (IRAM)

An integration test of the Band 3 warm optics was done at the EU Front End integration center at RAL. Results, including some design suggestion to improve the alignment, will be written up in a report.

Due to resource shortage at IRAM and hospitalization of one of their key staff, IRAM management has decided not to continue with detailed design and prototyping of the amplitude calibration device. The task has been taken back by ESO ALMA FE IPT staff and several alternative solutions to execute this work package have been identified. The major part of this work is the design and prototyping of the mechanical part. This item was to have been contracted out to industry by IRAM, and the same approach will be taken by ESO.

Meanwhile, RAL has continued to work on optimizing the fabrication process of the RF loads using an Al casting technique (Figure 4.1).

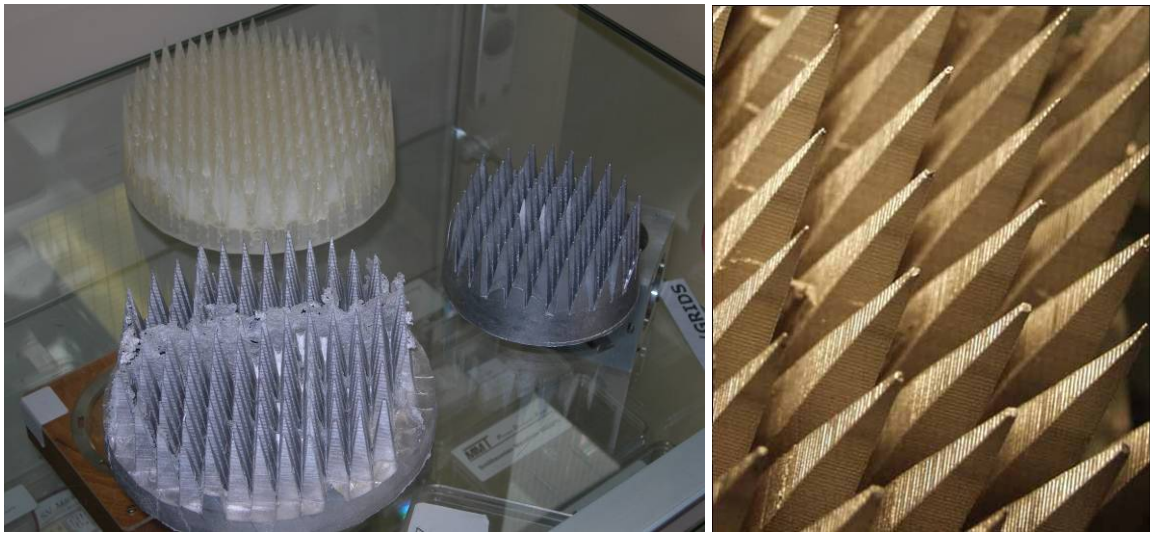


Figure 4.1 Rapid prototype mould and Al castings for RF load *Detail of Al casting*

4.2.5 Band 3 Cartridge (HIA)

Acceptance testing was completed for Cartridge #2; there will be some performance data not available for this first deliverable; in particular, the beam pattern measurement system has not yet been delivered to HIA by the manufacturer. Cartridge #1 is undergoing acceptance testing. Assembly of cartridge #3 is in progress.

Delivery of the first cartridge to the FEIC will occur in the third quarter of 2006.

4.2.6 Band 6 Cartridge (NRAO)

All acceptance testing for cartridge #1 was completed with the exception of measuring gain saturation, which is in progress; this is a very difficult measurement. Construction of cartridges #2 and #3 was completed, and they are awaiting test.

The documentation and procedures are ready to support PAI and PAS for cold cartridges. Delivery of the first cartridge to the FEIC will occur in the third quarter of 2006.

The fraction of the total mixer chips diced, lapped, and sorted increased from 36% to 42% during the quarter. The fraction of mixer chips DC tested and ready for installation in mixers increased from 8.4% to 13.7% during the same period.

Measures put in place during this period have eliminated mixer infant mortality. Test and certification of mixer-preamps are now proceeding normally. There are now enough qualified mixer-preamps to complete the first 6 cartridges.

The prototype cold cartridge was subjected to a vibration test in conjunction with the vibration tests done on the FE LO WCA. The test showed that a few construction details needed to be improved; the most significant being that one of the IF hybrids must be rigidly attached to the mirror support frame. These changes have been implemented on the pre-production cartridges.

4.2.7 Band 7 Cartridge (IRAM)

Band 7 Cartridge #1 and Warm Cartridge Assembly #2 with warm IF amplifiers were shipped to the NA Front End integration center on Tuesday, 27 June. This is the first cartridge in the ALMA Project that has officially been delivered to an integration center.

The status of the other Band 7 cartridges is:

- Cartridge#2 is 100% tested.
- Cartridge#3 is in the cryostat for final tests
- Cartridge#4 is 100% assembled.
- Cartridge#5 is 70% assembled.

In parallel, the documentation package for the Critical Design review has been prepared. The CDR meeting will be held on 16/17 August 2006.

4.2.8 Band 9 Cartridge (SRON)

A first Band 9 cartridge has been fully assembled and tested. The acceptance documentation package is being prepared.

This unit is still based on the old multipliers and needs to be refurbished in the near future with the new multipliers and WCA made available by NRAO.

A contract amendment for this work package was approved by the ESO Finance Committee in their May 2006 meeting. Following this approval, the necessary administrative steps (updating Statement of Work and placing a contract amendment with NOVA) are being taken.

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

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

Band 3: 3-3, 3-4, 3-5
Band 6: 6-5
Band 7: 7-4
Band 9: 9-3

The following were completed, but not yet delivered:

Band 6: 6-6

The Band 9 LO power issue has been essentially settled by tests of a X9 multiplier driven by a custom BAE Systems GaAs pHEMT power amplifier chip fabricated to our design. This was demonstrated at SRON to provide more than enough power over the required range with low IF noise contribution except at one frequency (under investigation).

A CDR for the FE LO system was scheduled for 27/28 July 2006.

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

The Mixer Test Lab temperature control was improved by moving the thermostat for the general lab area into the test room, and the test equipment for the OMTs in that lab is now showing satisfactory stability.

Two Band 3 OMTs were delivered to HIA. Two Band 6 OMTs were delivered.

There are at present six Band 3 OMTs fully tested, warm and cold. There are four Band 6 OMTs built and awaiting test.

4.2.11 Front End Assembly Design and Construction (NRAO)

Work on the detailed mechanical and electrical design and prototyping of the Front End continued.

The mechanical design of the electronics chassis progressed well. The layout of the wiring and cabling including power, IF, and fiber optics was completed. Work continued on the simulation and analysis of mechanical deformations of the chassis in conjunction with final FESS analysis. The thermal analysis of the chassis was postponed and is now scheduled to be performed by an external consultant in the 3Q 06; it will require 4-6 weeks to complete.

Integrated testing began for the complete FE Monitor and Control system, with the exception of the cryostat M&C. A revised version of the voltage regulator module of the cartridge power distribution system was completed and sent out for fabrication.

Extensive redesign of the DC Bias module and the 102-pin hermetic connector was performed. A review of requirements and design issues was included in the agenda for the scheduled cartridge builders' face-to-face workshop 25-28 July in Charlottesville..

4.2.12 Front End Integration Center Design and Construction (NRAO)

The second tilt table was installed at the FEIC. The environmental chamber for the Front End Test and Measurement System (FETMS) was delivered, installed, and accepted. It was built around one tilt table; the temperature-sensitive electronics were then moved inside (Figure 4.2). The cartridge loader was successfully used to install a cold cartridge. A second 50-Hz generator was installed along with the required extra power wiring so that the test equipment and the FE assembly under test will all be powered by 50 Hz.

Work continued on other components of the FETMS. The cold load system and the chopper wheel hardware were installed on the tilt table. Wiring of the tilt table, including cables which must pass through a cable wrap, was started.

Agreement was reached on the conceptual design of the LO Reference Test Module (LORTM). A contract for the detailed design is expected to be placed in 3Q 06, and procurement of five modules is expected to be placed in 4Q 06.

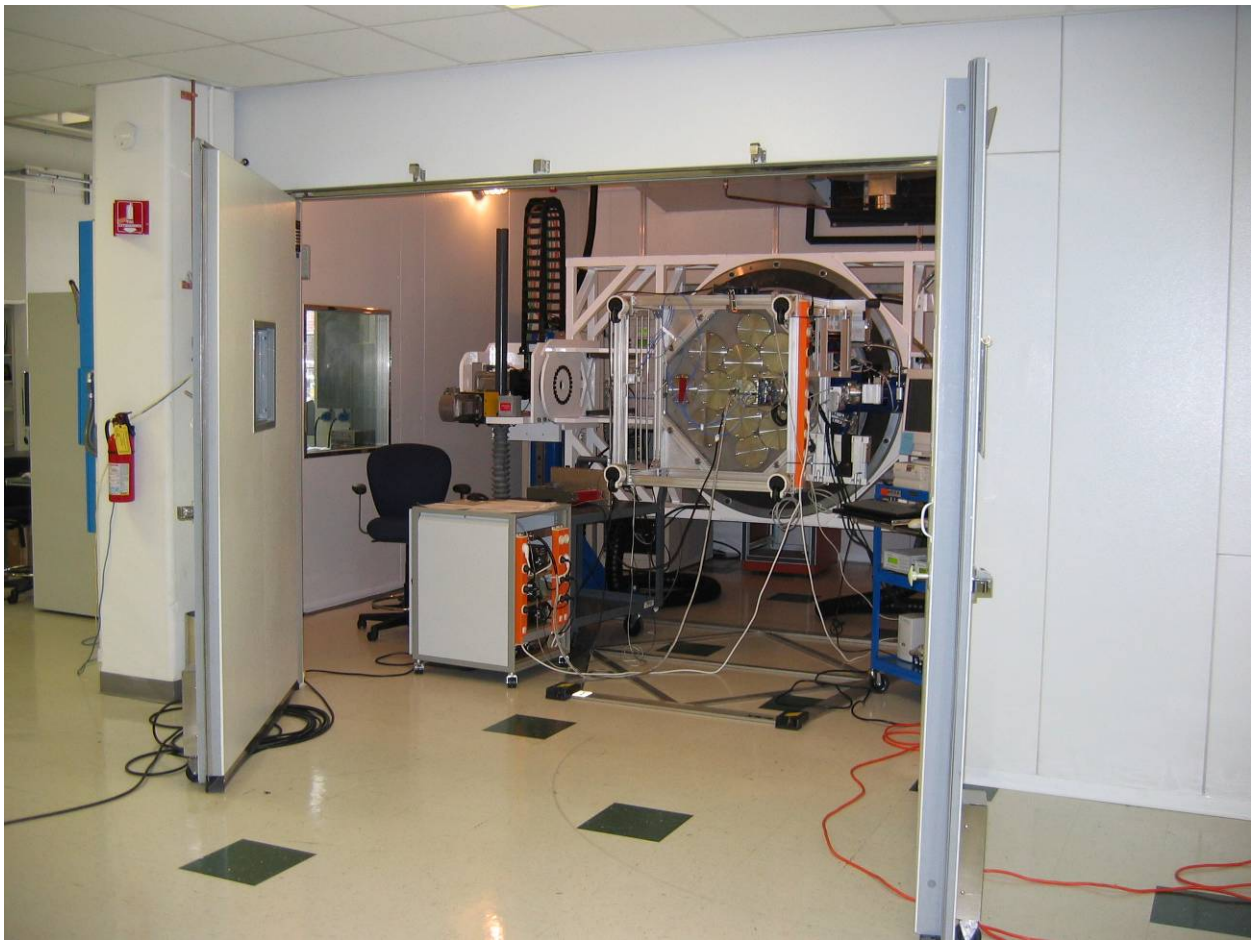


Figure 4.2 Front End #1 under test in environmental chamber at NA FEIC

4.2.13 Front End Integration Center Design and Construction (RAL)

Substantial progress has been made in refurbishing the building that will accommodate the EU FEIC (Figures 4.3 and 4.4). New paneling has been installed to make separate laboratories and integration facilities according to the requirements for the Front End AIV tasks. ESD safe floors and new electrical wiring have been installed.

Figure 4.3 European Integration Centre at Rutherford Appleton Laboratory / UK

Figure 4.4 Panoramic view of the European FEIC building (arc shape is an artifact of photography)

4.2.14 Water Vapour Radiometer (CA/OSO)

Field testing of the two prototype Water Vapour Radiometers continued at the SMA site. The data obtained is being analyzed and a report is in preparation.

Meanwhile CA and OSO staff are working to complete the agreed documentation package describing the prototype equipment.

4.2.15 Holography System (NRAO)

The revised holography receiver #1 was completed and testing began. Design of the transmitter was completed and ordering of parts began. A plan was agreed on deployment and testing, first at the ATF and then at the OSF.

4.2.16 ALMA-J (ESO, NRAO, NAOJ)

Work continued on the LO systems for Bands 4 and 8. It was agreed between the LO group and the Band 8 group to change from a multiplication factor of X5 to X6, which will allow use of a GaAs power amplifier.

4.3 Planned Activities for Next Period (ESO and NRAO)

For the period July-September 2006, we plan to:

(1) Complete specifications for amplitude calibration device and place contract for prototype construction.
(2) Receive first Band 3 cartridge at the NA FEIC.
(3) Receive first Band 6 cartridge at the NA FEIC.
(4) Complete the CDR for the Band 7 cartridge.
(5) Prepare the Band 9 cartridge CDR documentation package.
(6) Complete the first release of the software for controlling the FE and the FETMS.
(7) Assemble the first FE and begin integrated testing, particularly for EMC, using at least Band 6 and Band 7 cartridges.
(8) Complete assembly of pre-production cryostats #7 and 8.
(9) Deliver all remaining pre-production cartridge bodies.
(10) Prepare updated WVR Technical Specifications as required for detailed design and production.
(11) Investigate remaining IF noise issues for the LO system.
(12) Fabricate and test the Rev. D DC Bias components.
(13) Receive and install the FETMS beam scanner at the NA FEIC.
(14) Place contract for detailed design of the LORTM.
(15) Complete testing of the holography transmitter.
(16) Complete SOW, ICDs, and requirements for the Service Vehicle.
(17) Continue evaluation of WVR performance.
(18) Complete the building infrastructure at RAL for the EU FEIC.

5 Back End IPT

5.1 Planned versus Actual Accomplishments over the Period

- Product Acceptance Plans for antenna BE LRUs (Line Replaceable Units) prepared to the extent practicable at this time. BE has uploaded Verification/Acceptance Plan document to EDM (Electronic Data Management) for review.
- PSI and BE have performed verification testing for prototype BE modules, although e2e tests may yet uncover additional problems. *NA and Euro*
- Procurement documents for prototype Central Variable Reference completed and bids received. A Request for Waiver to remove VLBI (Very Long Baseline Interferometry) phase stability requirement was posted to EDM.
- A specification review for the procurement of the production Master Laser has led to plans for an interim SoW (Statement of Work) to measure performance of new fibre lasers and other reliability issues before full procurement is approved. Since the Master Laser procurement impacts the Laser Synthesizer procurement, both production procurements are delayed until October to await results of the interim SoW. *NA*
- Problems with 125 MHz LO Reference phase drift and noise have been identified and corrected. *NA*
- Installed firmware modifications to 1st and 2nd LO synthesizers and DTS (Digital Transmission System) to eliminate Timing Event ambiguity on start-up. CREs (Change Requests) for ICDs (Interface Control Documents) with CIPT (Computer IPT) initiated where appropriate. *NA*
- Continued negotiating completion of external ICDs. *NA and Euro*
- Completed shipment of DTS de-formatters (new design) for one rack of 1st correlator quadrant after allowing for TFB (Tuneable Filter Bank) contributions to timing problems. Acceptance documents prepared. *NA*
- Planned modifications to digitizer assembly to provide remote tuning, test patterns, and clock synchronization; however, final design awaits result of on-sky tests at the ATF (Antenna Test Facility). *Euro*
- University of Bordeaux submitted a thermal characterization of the Digitizer and Digitizer Clock assemblies. *Euro*
- The AOS TB (Array Operations Site Technical Building) anchoring system design is 75% complete. Some missing rack details caused some minor delays. A final review and delivery of the design to Site IPT is expected next Quarter. *NA*
- Started procurement process of the AOS internal fibre system. *Euro*
- Pre-production Optical Mux-Demux/EDFA (Erbium Doped Fiber optic Amplifier) were delivered for use in PSI (Prototype System Integration) testing. *Euro*
- Response to NAOJ (National Astronomy Observatory of Japan) SoW for delivery of BE modules to ACA (ALMA Compact Array) submitted to respective executives. *NA and Euro*
- Draft agreement for off-loading certain BE production work to ASIAA (Academia Sinica Institute of Astronomy and Astrophysics) submitted to NAPO (North American Project Office) for approval. *NA*
- PSI installed a temporary over-temperature sensing and shutoff in prototype antenna racks; but the BE design is still in progress. *NA*
- PSI has identified problems with the BE digital sampling and transmission system; most have been corrected, although additional e2e and on-sky tests may find more problems.

One uncorrected problem is a variable delay on power-on with metaframes in data channels. *NA and Euro*

- Completed RFI (Radio Frequency Interference) performance testing to the extent currently practicable. Some additional testing may be required for full systems to be able to report compliance. *NA*
- Commented extensively on Project System Requirements Review (SRR) and subsequent documents, but still need to review BE design for changes once system requirements are completed and approved. *NA and Euro*
- The SRR recommended the procurement of a COTS (commercial off the shelf) device for the Master Frequency Standard. An RfW has been submitted to allow the usage of an Ethernet interface instead of the AMB interface, which would require substantial customization. *Euro*
- Over 100 documents have been entered in the EDM controlled document area. An equal number of documents are awaiting internal review and approval. *NA and Euro*
- Delivery of components for FEIC (Front End Integration Center) tests have been identified and scheduled. The first of two timing racks for antenna holography have been delivered to FE IPT, and a SoW has been approved for an abbreviated Central LO to be used by AIV (Assembly Integration Verification) for single antenna testing. *NA*
- Racks and mock on-axis antenna fiber optic cable wraps for Antenna Acceptance testing shipped to Chile. *NA*
- Requests for Waiver (2) from M&C (Monitor and Control) interface requirements posted to EDM for review. *NA and Euro*
- Although a Computing IPT test report for the Prototype DGCK shows a few discrepancies with current M&C specs (which are newer than DGCK specs), the device is suitable as is for the PSI tests. Implementation of new requirements can be considered for the production version. *Euro*
- Six pre-production Digitizer Clock Assemblies shipped to ESO. *Euro*
- The delivery of the Photonics LO pre-production photomixers from RAL has been delayed to allow meeting slightly different specifications; no impact on overall schedule. *Euro*
- Improvements and upgrades to the prototype Laser Synthesizer and Line Length Corrector enhanced PSI operation. *NA*

5.2 Technical Status and Technical Performance Results Achieved over the Period.

- Interaction between LO reference and LO Photonics reference signals on the single optical fiber used to relay both references from the Central LO to the antenna caused phase instability. Those problems have been identified and corrected (though not fully tested). *NA*
- Procurement of pre-production IF (Intermediate Frequency) processors released. *NA*
- Conversion of DTS formatter and de-formatter to “1/2 transponder” optical components required a firmware re-write, but both conversions were completed successfully.
- PSI reports successful cross-correlated e2e results using prototype modules. *NA and Euro*

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) Additional problems with integrating the digitizer assembly, digitizer clock, and DTS formatter may be identified during on-sky and other e2e testing, 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*
- Procurement of IF processor pre-production modules for the 1st antenna and PSI testing has been approved, but the timing for delivery is tight and could cause a delay in delivery for outfitting the 1st antenna in Chile. *NA*
- Although a successful proof of concept has validated the LO Photonics design, some risks remain: 1) Need to develop a fiber stretcher with low polarization change versus stretch position to meet phase drift requirements, 2) Need to test for phase drift introduced by on-axis LO Fiber Optic Cable Wrap during antenna motor accelerations, and 3) Need to improve reliability of Cable Wrap. Final design, development, and procurement of LO Photonics components for the Central LO are behind schedule, which could delay on-time delivery in 2008.
- A test stand needs to be built for performing DTS acceptance tests. The original plan called for using the Prototype Correlator for testing. The design of an e2e test stand for the DTS system has been identified and construction initiated. *NA*

5.4 Planned Activities for Next Period (July - September 2006)

- Complete Acceptance Plans for pre-production antenna modules. *NA and Euro*
- Complete verification testing of antenna prototype modules for PSI. *NA and Euro*
- Finalize procurement documents for Master Laser, Laser Synthesizer, and prototype Central Variable Reference. *NA*
- Test for interaction between LO Photonics and 125 MHz LO Reference that led to phase instability. *NA*
- Continue negotiating completion of external ICDs. *NA and Euro*
- Update plans for digitizer assembly based on sky tests at ATF. *Euro*
- Conduct review and deliver rack anchoring design for AOS TB to Site IPT. *NA*
- Continue procurement process of the AOS internal fibre system. *Euro*
- Initiate recruiting additional personnel to accommodate ACA build for NAOJ, if requested. *NA*
- Initiate SoW for ASIAA contributions to BE build. SoW will use draft agreement as enclosure until agreement ratified. *NA*
- Complete installation of over-temperature sensing and shutoff in prototype antenna racks. *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*

- Complete delivery of components for FEIC tests, antenna holography tests, and AIV single antenna tests. *NA*
- Support PSI tests and move of prototype antenna racks to ATF, if scheduled. *NA*
- Complete fiber optic cable and connector design for production antenna. *NA*
- Plan for receiving first article pre-production IF processor for integration and test. *NA*
- Release procurement of first production IF processor modules. *NA*
- Initiate construction of all pre-production hardware and rack integration for 1st antenna. *NA*
- Continue development of product test stands for OSF (Operations Support Facility) and prepare to ship. Train AIV personnel on use of test stands, when AIV personnel become available. *NA*
- Plan environmental testing for antenna racks (temperature and vibration). *NA*
- Conduct specification review for production Laser Synthesizer. *NA*
- Continue design and development of LO Photonics Central LO for shipment in 2008. Complete evaluation of impact on PMD (Polarization Mode Dispersion) of various line stretchers. *NA*
- Receive Photonics LO pre-production photomixers from RAL. *EU*
- Provide support to Site IPT for the AOS Fibre system construction. *EU*
- Procure the Master Frequency Standard. *EU*

5.5 Milestone Summary

Back End	**9120**	**1.05.260.0055**	**All NA BE Production Contracts Placed**	**Planned**	**13-Nov-07**	**7-Apr-08**	**NRAO**
Back End	**Internal**	**1.05.262.3520**	**All ESO BE Production Contracts Placed**	**Planned**	**13-Jul-07**	**13-Jul-07**	**ESO**
Back End	**Internal**	**1.05.305**	**1st antenna racks (A & D) ready for shipment to OSF**	**Planned**	**12-Feb-07**	**1-Mar-07**	**ESO & NRAO**
Back End	**Internal**	**1.05.290.3760**	**AOS Int. Fibre System Ready for Use (Ant & CORR)**	**Planned**	**11-Dec-07**	**14-Apr-08**	**ESO**
Back End	**Internal**	**1.05.305**	**1st Set of Central LO racks to AOS-TB Ready for Shipment**	**Planned**	**29-May-08**	**23-Apr-08**	**ESO & NRAO**

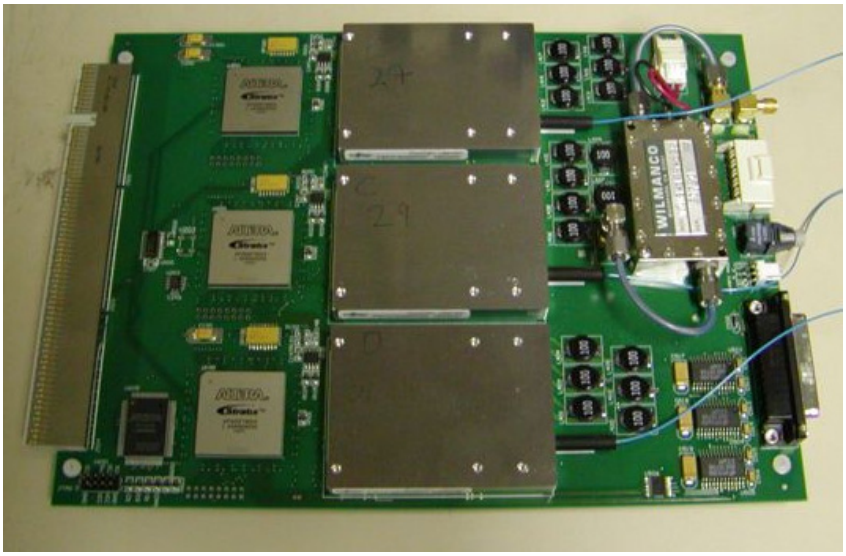


Figure 5-1. *The new optical "½ transponders" occupy 1/3 of the DTS formatter board but save construction of 3 separate circuit boards.*

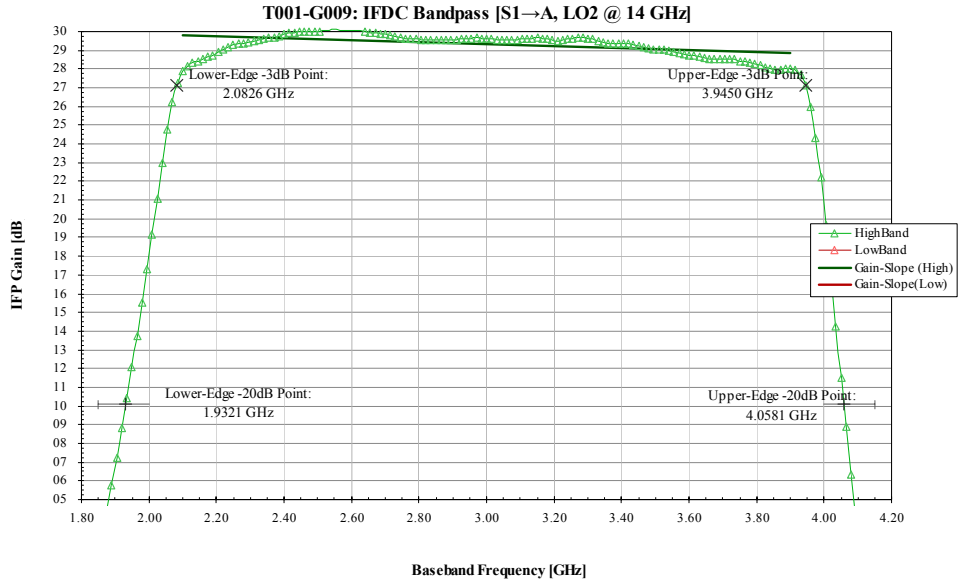


Figure 5-2. *The output frequency bandpass performance of the IF downconverter meets current system technical requirements.*

6 Correlator IPT

6.1 Overview

This report covers the period April-June 2006. The Correlator is in an advanced state, and the part of the system (Tunable Filter Bank Cards), supplied by U. de Bordeaux under contract with ESO (the European ALMA Executive), is already being integrated into Quadrant 1.. 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 April-June 2006 were:

(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.

The status of these goals is as follows:

(1) No activity—none required. All production boards have been received and nearly all have been tested for all 4 quadrants.
(2) Accomplished. Two chips failed in April, none since then.
(3) Accomplished. Development and testing continues.
(4) Completed. The Stratix II version was selected for production.
(5) Nearly completed; no major difficulties, but negotiations still ongoing.
(6) Completed.
(7) Measurements were done, indicating need to adjust air flow among and within racks. As a result, adjustable-aperture panels between Station Rack bins were designed.
(8) Not completed; work is in progress.
(9) Racks were moved into the test room but population was delayed so that air flow adjusters can be installed before boards and cables are attached.
(10) Delayed pending resolution of air flow questions.

In addition, the following tasks were accomplished during April-June 2006:

(1) The Correlator IPT supported PSI in Socorro by supplying firmware updates for the prototype correlator.
(2) Thermal simulator cards were designed and built to aid in adjusting Station Rack air flow.
(3) A comprehensive plan for TFB construction and testing was written.
(4) Configuration of racks in the AOS TB correlator room was reviewed and modified to allow for extra Computing IPT communications racks.

(5) Deep analysis of the correlator data obtained with a new DTS receiver simulator and the TFB card has been performed; the "platforming" effect resulting from subchannel stitching is fully understood (and can be corrected).
(6) Work began on "mixed modes" which will allow different resolution spectra to be analyzed simultaneously.
(7) Significant progress was made on writing and updating hardware manuals.
(8) The conceptual design for under-floor bracing was started.
(9) A workshop on digital filters and phase linearization of IIR filters with potential applications to ALMA has been organized.

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 3-4.

Production Tunable Filter Bank (TFB) cards: prototype cards have been tested in the correlator, and all technical details for production are now known.

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 for Production

Following delivery and successful tests of TFB Stratix II cards in the correlator, we have held a TFB card meeting to review our design and to definitely select the filter chips for production. The review showed that the design is ready for quantity production, conditional to the completion of some complementary actions; nearly all of these actions were completed by the end of June 2006.

One difficult action was to investigate the impact of leadless soldering, because there is no industrial experience yet with the ROHS regulations (implying reflow temperatures around 20°C or more above the standard lead procedures). Once we selected our card assembler, we adopted a pragmatic approach based on intensive discussions and exchange of information with our assembler and various card manufacturers to define a highly reliable card fabrication and assembly process. In conclusion, we have to: (1) implement some modifications to our original card design (in particular, make all card layers equally thick to minimize possible warps and non-planarity problems on the top layer), (2) select the appropriate card material, and (3) use a "vapor phase" process to assemble components (to accurately control maximum temperatures).

In parallel, analyses of the TFB cards data in the correlator have continued, as well as some filter firmware developments. In particular, "statistical functions" have been implemented to better diagnose at the system level communication between cards

and/or various parameters of interest for the ALMA DTS sub-system (e.g., digitizer statistics or DC offset).

A new delay chip personality has also been designed and tested to allow for fine delay synchronization with the bulk delay.

6.3.4 Highest Level Risks and Concerns

There are at present no major concerns. A minor concern is air flow adjustment for optimal cooling.

6.4 Planned Activities for Next Period

The goals for July-Sep 2006 are:

(1) Continue burn-in of ALMA-1 chips and replace those which fail;
(2) Continue development of firmware and software;
(3) Complete ESO-Université de Bordeaux production contract for Production TFB cards;
(4) Complete subcontracts for TFB FPGAs supply;
(5) Complete subcontract for TFB card production and assembly;
(6) Complete re-routing of production TFB cards and launch first production;
(7) Prepare acceptance plan for production TFB cards;
(8) Measure temperatures and modify air flow within the Station and Correlator Racks to optimize heat removal;
(9) Complete the test and acceptance plan;
(10) Populate Quadrant 2 racks and begin integrated testing;
(11) Review readiness of Quadrant 1 for shipping.

6.5 Milestone Summary

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

Quadrant 1 is ready for disassembly and shipping. However, this is postponed so that firmware and software development can continue while air flow adjustment for Quadrant 2 is in progress. Rack construction for Quadrant 3 will be done in the lab adjacent to the correlator test room (the racks have been delivered already).

7 Computing IPT

7.1 Accomplishments this Period

7.1.1 Whole IPT

- Software Release R3.1

Releases R3.1 included a number of improvements on the software prepared for optical pointing and regression tests that should allow verification before porting software to the ATF for the final validation. R3.1 occurred as scheduled at the end of March 2006. The integration work on this release took only two weeks. Further work to port the software on the AEC antenna was then performed, which proved to be useful to discover not only new problems to be sorted out but also commissioning functionality that was needed. The R3.1 software was then ported also to the Prototype System Integration Laboratory (PSIL) in Socorro where the hardware for single field interferometry is being assembled and tested.

- Computing Subsystem Leads meeting.

The yearly meeting of the Computing subsystem Leads was held in Garching on 26-19 June.2006. Design discussions on issues going across subsystems, procedures (for integration, testing, etc.), and computing policies were discussed. A yearly meeting is necessary to keep subsystems aligned and to discuss future developments, taking advantage of the experience and point of view of the various subsystems of ALMA software.

- Function Based Teams (FBT)

Following the successful deployment of the function team across subsystems, used for the first time for the optical pointing functionality up to end of March 2006, it was decided that all major developments will be based on functional teams. This will mean that most development will be driven by the functionality needed to achieve high-level functions and Computing subsystems will allocate staff to these teams, which have typically a short duration (two months).

The advantage of being able to concentrate on high-level functionality is clear, but there will have to be several teams in parallel in the next period to cope with all that is planned. In particular, the following FBT Teams were started:

- Shared Simulation Functional Team

A Function Team (involving most subsystems) to implement and test the so-called Shared Simulator was started at the end of February for a development period of two months. This has the purpose to achieve interferometric fringes in simulation, in view of future interferometry to be done at the ATF. The main responsibility for this work is with ESO. This work was concluded at the end of April as planned and contributed to show that the system can work properly, although no real hardware was involved.

- Monitor Database, Telescope Configuration DB

The work of this Team involving Control, Archive, and ACS, has to do with optimizing the storage of monitor values (all engineering and other data, which are not the science data). This work is still on-going. It will be followed by work on the use of the Configuration DataBase (CDB) of ACS by Control, which shall allow for tracking the history and exact configuration of all components within ALMA.

- Holography

The software to cope with the holography receiver within an e2e concept is being prepared by a functional team. This work should be finished during the month of August, when the holography receiver will become available.

- APDM re-factoring, Calibration DB

The ALMA Project Data Model needs upgrading because of Holography and future single field interferometry. The Calibration Database needs to be established.

7.1.2 CIPT Management

- Critical Design Review 4 (CDR4).

The Critical Design Review 4, namely the annual review meant to plan the features to be implemented by every Computing subsystem in the next year and their design, was held on May 17-19. This came after a process in which design and planning documents had been updated about the Features to be implemented in the next year (next two releases). After this written comments and replies were collected, so that in 3 days the Computing IPT management staff could hold teleconferences with all Subsystem- and Common Activity-Leads (16). This resulted in a number of upgrades requested to finalize the above documents and in about 120 detailed actions on work to be done during next year.

- Interviews for ALMA IT Manager and AIV Computing staff (4) in Chile.

These involved the two EU and NA CIPT Leads. AIV staff will be trained mostly at ATF, but participation to developments in Socorro and Garching are also foreseen. It is expected that the new staff recruited will provide a continuous software support at ATF.

7.1.3 ALMA Common Software (ACS) (mostly EU)

- ACS 5.0.

ACS issued a major release in Oct (ACS5.0) but did not have a minor release in April ACS5.1, as people took part in the Control work where support was needed. The missing release was replaced by patches, as required.

  - Improvements in error handling and improved examples
  - Major refactoring of jlog to drastically improve stability and performance, as requested by Optical Pointing test report.
  - Completed update of WebStart to JDK 1.5 and tested.
  - Improved performance of ABeans-based GUIs and tested/extended mount GUI for Control
  - Work in the RTOS functional group to test and cleanup RTOS code, mainly in Control and Correlator. Reviewed modules and implemented new tests.
  - Work on Bulk Data Distributor. In particular, did performance measurement tests.

- ACS 6.0.

The next major release is planned for October 2006 and will be ACS6.0. Meanwhile, the new Alarm system will be deployed on the Scheduler to finalize it, before it is used by Control.

7.1.4 Archive Subsystem (mostly EU)

- Support of FBT work

- Mission to Socorro
- Finish work for Monitor data functional team

- Science Archive

  - Archive face-to-face meeting
  - Participation in IVOA interoperability meeting

7.1.5 Control Subsystem (mostly NA)

- Control and FBTs

Control software was always involved in the Functional Team work. After Optical Pointing, the work on Single Filed Interferometry (in simulation) and Holography started, together with work on the monitor database (optimization of monitor data archiving for easier retrieval). The new control software is more and more becoming an integral part of the whole e2e ALMA software, not just a stand-alone tool to test antennas and additional equipment.

- Completed shared simulator work and merge.
- Completed the redesign of the monitor database:
- Worked on definition of a hardware device lifecycle model with control over starting and stopping the monitor of properties.

- PSIL support

Quite some development work went into new drivers for PSIL and to support integration tests in the lab. The PSIL work also provides a lot of feedback that is contributing to improving the stability of the Control software. A basic level of software to support first fringes at the ATF has been developed during this period.

- Extended code generation system for device drivers, adding concepts for status bits and fast monitoring.
- Completed phase two testing of the IF-processor in the PSI lab and started work on testing the GPS receiver and central reference distributor.
- Continued work on the AMBSIs, fixing a firmware bug involving AMBSI failure on broadcast ID request.

- ATF tests

Tests of antennas by CIPT and AIPT required support on several occasions during this period.

7.1.6 Correlator Software (NA)

- RTOS platform improvements

Important improvements on the stability of this software happened, in connection with difficulties encountered (but eventually solved) having to do with the real time operating system version in use.

- Work on correlator monitor database and device code generator were begun.
- Wrapped up necessary functionality requested by PSIL users for CorrGUI.

- Began work on multiple baseband configuration validation in preparation for SFI work later this year.

- Correlator simulator

Development of a version of this software capable of being run in simulation has been started. This is important to test the whole ALMA software, independently of the correlator hardware being present or not. Non-RTOS code refactoring work was completed., but tests exposed serious timing problems which prevent the correlator software from working correctly

7.1.7 Executive Software Subsystem (EU)

- Operator GUI

This subsystem deals with the Operator Graphical User Interface. This was installed for the first time with Optical Pointing and is now being improved, and at the same time is in use at the ATF. Developments for an improved operator GUI are on-going.

- Implementation of Special SB creation from calendar events
- Made basic code for array creation and antenna monitoring
- Test and deliver panel for array creation and antenna monitoring

7.1.8 High Level Analysis

- Lead of Shared Simulator FBT

This activity now consists in making sure that the whole architecture is consistent and in supporting integration tests. One major activity during this period was to lead the FBT on Shared Simulator, to prove that the software is in principle capable of handling interferometry data.

- Modified code generation infrastructure to meet requirements of ApdmRefactoring FBT; merged results to HEAD and to Holography branch.
- Began planning for ObservatoryCharacteristics FBT
- Discussed units standardization and API with Control, Offline and ObsPrep

7.1.9 Integration, Test, Support

- Frequent Integration

The function based teams require frequent integrations of their work (technically on a Branch of the main development) into the main baseline (called Head). This means the ITS team is better approaching the theoretical model of a continuous integration, hard to achieve otherwise in an extremely distributed development.

- completed Shared Simulator validation in STE and ATF;
- completed e2e automatic test for Shared Simulator validation
- integration and test for Monitor Database
- usual support, installation, and trouble shooting in PSIL/ATF

7.1.10 Observatory Operations Support Software (EU)

- Status

This is a new subsystem, started at a low level of effort, in the second part of last year. It provides all that software, which is not running on-line every day, but which is needed to get the whole end-to-end operations completed, from support of Time Allocation committees to delivery of data packages to PI's. The Preliminary Design Review for this subsystem was passed at CDR4.

7.1.11 Observing Preparation and Support (EU)

- APDM re-factoring

The Project Data Model (APDM) was re-engineered, based on feedback received at various tests.

- Significantly changed APDM, a new system view editor, agreement on and implementation of support for "special" SBs, and a variety of other smaller enhancements.
- Example projects regenerated, including those necessary for OP and SS testing.

7.1.12 Offline Subsystem (mostly NA)

- CASA

New CASA platform provided to Pipeline for their work. Updated Data Capture software and Data Models to reflect needs of functional based teams.

7.1.13 Pipeline Subsystem

- Use of CASA and Python

- Heuristics development switch to CASA framework completed
- Port of all heuristics scripts to CASA framework completed
- Work on single dish flagging heuristics started
- Work on pipeline cluster / machine configuration issues started
- Work on quicklook operator GUI interface started
- Continued progress on quicklook data displays .

7.1.14 Scheduling Subsystem (NA)

- Scheduling system is running with the new APDM changes
- Simulator is running with real weather data files (files are slightly modified)
- Scheduling Panel is functional, although there is a lot of additional work to do to provide feedback.

7.1.15 Science Software Requirements Committee

- SSR tests

In this phase, the work of the SSR Committee (mostly senior radio-astronomers contributing their time for free) consists of monitoring the developments of the various subsystems and taking part in dedicated tests. In addition, campaigns to do integrated tests, as in the one for Optical Pointing, are organized.

- Integration of ACA software requirements into the bilateral SSR requirements.

Review meeting on ACA detailed requirements was done. Changes due by the end of July on OT and Correlator/control requirements. Off-line requirements will be reviewed around Aug 1st.

7.1.16 Software Engineering (EU)

- Computing standards

This activity consists of maintaining the ALMA computing standards, programming rules, and checking the quality of the software being produced. This is done automatically via nightly builds and tests of the software under development.

7.1.17 Telescope Calibration Subsystem (EU)

- Finalization of ASDM tables for holography
- Holography work; handled new tables (Pointing and Total power including binary).
- Tested engines with ASDM data.

7.2 Activities Next Period

- Continue Functional Based Team work up to Release 4.0 (end of September)
- Work on ACS and Archive Release 6.0 (end of October)
- Support holography tests at ATF (August)
- Support PSIL preparations for final tests before moving equipment to ATF

8 System Engineering & Integration IPT

8.1 Engineering

8.1.1 Requirements and ICDs

- Preparation and carrying out of a wider review of the system requirements, which included:
  - Close out of AI and update of 12m array system requirements.
  - Operations requirements: Completeness and linkage to system and sub-systems requirements.
  - Communality of Computing Control requirements and design.
  - ACA System requirements and interfaces to 12m array.
- Following the system requirements review, substantial effort has been spent in closing the Action Items and updating the ALMA system requirements. Entries and dependencies were added into the ALMA database of the Science; System, and top-level IPT subsystem requirements, and ICDs were updated. ALMA proect wide specifications are 92% completed. ALMA external interface control documents are 80% completed.

8.1.2 Design and Analysis

- The three-dimensional model of the Vertex and AEM antenna receiver cabin with its interior has been developed and refined. A review was done and the documents updated, refined, and distributed to all relevant IPTs.
- The Antenna cabling design is an ongoing activity. Cable types and electrical interfaces between all ALMA equipment to be installed on the antennas have been identified and documented. Apart from the cable length, the cabling shall be uniform throughout all different antennas. The ALMA antenna cabling design was prepared and distributed for both Vertex and AEM antennas, and sent to NAOJ as template information for the MEICo cabling design.
- The mechanical tolerance budget was updated; consolidating all available information in the Front End and Antenna IPT into one table.
- Support was given to the Front End regarding FESS design and cryostat acceptance, through reviewing design documentation and attending acceptance and review meetings.
- First version of the ALMA sensitivity budget has been released.
- Master frequency Standard specification was prepared and procurement process was initiated.
- Support was provided to the Antenna IPT for the ridges procurement and the design and manufacturing of the alignment tool for the ridges to be installed in the antenna station.
- ALMA system block diagrams have been updated, refined, and distributed. Discussions about the required optical design and analysis tasks were held. The sensitivity budget was further refined.
- System Engineering chaired and/or participated in several review meetings, .eg., the tunable filter band PDR and maser laser review.

8.2 Product Assurance

- In June, a candidate for the Product Assurance Lead position was interviewed, references were checked, and an offer was made to, and accepted by, Mike Rodriguez.

8.3 Prototype System Integration

- During this reporting period, prototype versions of all hardware modules plus monitor/control software were available and the main activity of PSI was to achieve system integration and robust connectivity in the lab. This means that the hardware is (in general) configured in racks as it will be for ALMA, reference signals are distributed throughout the system at their proper power level, oscillators are phase locked, phase noise and drift are within spec, spurious signals are at an acceptably low level, the data transmission links function as required, cross correlation spectra are produced by the correlator, and computer monitor/control of hardware is functioning. Also, after a setup period, the system functions for many hours without human intervention.

  After system connectivity is achieved, the next task will be to develop and exercise the control software needed for interferometry in the lab, with emphasis on phase switching, phase tracking, and delay tracking.

- A significant problem was detected in the Data Transmission System. When a signal generator was used to insert a spectral line at the digitizers, at some frequencies the output spectrum showed a beautiful narrow line, but at other frequencies the line was broken into numerous peaks. A software simulation showed that if a 32-bit block of data was swapped in time with the preceding block, the observed distorted pattern could be accurately reproduced. An error was found by the BEND engineers in the firmware in the DTS receiver FPGA, and the problem was corrected.

- Some stuck bits were found in the DTS transmitter and these were traced to connector problems.

- The Master Laser went out of lock intermittently for several days and was difficult to relock. A suspect switch was disassembled and cleaned and the problem disappeared. The unit still occasionally falls out of lock and there may be other problems.

- In April, the AOC HVAC failed and when staff arrived in the morning, the over-temperature sensors in the antenna racks had tripped and the racks shut down. However, the Central LO rack had continued running and was at 26.4C, instead of the typical 11C, when power was finally turned off. Inspection showed no permanent damage to hardware and the LO rack over-temperature protection was replaced.

- A visit to the Socorro AOC lab by the Charlottesville photonic group staff (and Pengbo Shen, University of Kent) resulted in an upgrade of the laser synthesizer, line length correctors, and LO warm multiplier assemblies, plus a continuation of 1st LO phase drift measurements. A test report on the photonic LO is being prepared.

- Excessive phase drift in the 125 MHz reference signals in the antenna racks was a problem. This was traced to a problem with the 125 MHz signal recovered in the LORR module. The phase of this signal was very sensitive to the power level of the optical reference signal, which in turn was dependent on the polarization of the optical signal; the optical polarization varies as cables are moved or vibrate. Changes in the design

of the LORR to remove this sensitivity were developed. An updated LORR module was expected by mid-May, however, implementation problems have delayed delivery. The PSI integration continues despite this known problem.

- By the end of June, system connectivity was largely achieved. A common signal at 102 GHz was injected into each leg of the RF simulator and the separate signal paths went independently through the AEM and VA antenna racks. The frequency of one LO2 was offset from the other LO2 by 0.01 Hz and the signals were sent to the correlator. A cross-correlation spectrum was produced and the phase plot showed the drift expected from the frequency offset.

- The move of the PSI hardware from the Socorro AOC lab to the prototype antennas at the ATF is scheduled to begin 28 August, pending success with interferometry in the lab. Detailed planning is underway.

8.4 Chilean Assembly, Integration, and Verification (AIV)

8.4.1 Management

- A cost estimate was prepared for the additional cost brought about by the AIV of ALMA-J contributions to the project. This estimate was delivered to the ALMA-J Project Manager.
- Recruitment began for the first group of Chilean Local Staff for AIV. A group of job descriptions was prepared, and the positions advertised in El Mercurio as well as on Chilean web services. The results were encouraging, bringing in about 400 applicants who passed the screening criteria. Interviews were held for electronic, mechanical, and software personnel with about 12 people identified as candidates to take to a final level of screening: psychological evaluation and high altitude medical tests. Most or all of the local staff hired in this process will be placed in the Executive facilities for periods of familiarization and training.

8.4.2 Activities Underway

- Highest priority is being given to preparation of facilities for Antenna Acceptance Tests scheduled to happen during the first months of ’07. This preparation includes design and execution of an interim laboratory, in lieu of the OSF Technical Facilities, from which to run some of the acceptance tests. It also includes planning for and preparation of holography infrastructure.
- A design was prepared and a tender has been released for the Interim Laboratory, a modular building of about 200 square meters in size to be located near the current ALMA Camp. The building is needed for occupancy by Q4 of ’06.
- The lists of test and handling equipment needed to equip the laboratory for antenna acceptance and for AIV were parsed into an “early” and a “later” group, and reviewed with IPTs in preparation for purchase of the first set of equipment in Q3 of ‘06.
- A standalone tower to support the holography beacon was specified in consultation with Darrel Emerson and the holography planning group, and was tendered with a view to completion before the end of ‘06.
- Design work has begun, together with the Computing IPT and with Christian Saldias, the JAO IT Manager, on the networking and computing design for the interim lab. The objective of the design includes the ability to provide secure and independent access by

antenna vendors as well as by the AIV team both onsite and in Santiago. It will also be capable of controlled access to specific hardware by the developers within the Executive labs. Network hardware is scheduled for installation in the interim lab and in the antenna under test in the Vertex area during Q4 of ’06.

9 Science IPT

9.1 Overview

During the period April-June 2006 , the JAO Project Scientist turnover continued, with Wilson in the post at the beginning of the period—he spent 4 weeks in Chile during May and June 2006 to complete his turn as interim JAO Project Scientist. Kawabe took over as JAO PS on 1 June. As Kawabe was unable to attend the Santiago Board meeting, Wilson acted in his stead.

The focus of the Science IPT remained timely feedback on the scientific acceptability of technical solutions and performance and the interpretation of the ALMA scientific requirements. A System Requirements Review was held in April, with a focus on the Atacama Compact Array. This Review was led by the Science IPT leadership and chaired by Darrel Emerson with organization by the System Engineering IPT. In June, the ALMA Board approved the ALMA Scientific Specifications and Requirements, ALMA-90.00.00.00-001-A- SPE, with a minor clarification. In June, a meeting was held in Santiago on ALMA Assembly, Integration, Verification, Commissioning and Scientific Verification at which IPT Leads scrutinized the plans for these phases of ALMA. The Science IPT leads the Commissioning and Scientific Verification portions; plans for these phases were presented and discussed under the leadership of Wootten, Laing, Wilson, Emerson, and Vila-Vilaro, with remote participation by Mangum and others. The composition of the Commissioning team was clarified and several action items identified for resolution over the coming months.

A second focus of the Science IPT has been on Calibration. Several internal reviews of elements of the Calibration Plan were conducted, with action items identified, acted upon, and closed (see below).

At the Kyoto meeting, the Board asked the Science IPT to revise the Design Reference Science Plan to include elements brought to ALMA as a result of Japanese participation. A Call for the DRSP2.0 projects has gone out. Changes were made to the ALMA sensitivity calculator to accommodate the enhancements. The projects will be collated and reviewed during the upcoming quarter.

9.2 Scientific Advisory Committees

The Science IPT facilitated the ASAC telecoms, providing communications, agenda and documents to support their deliberations. During the June meeting, the Board concurred with the replacement of ASAC member Chris Carilli (who had been appointed Head of the North American ALMA Science Center) with John Bally, of the University of Colorado.

9.3 Technical Status and Technical Performance Results Achieved

All Science IPT goals are on schedule and at or under cost. For North America, 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 assisted in developing the proposal for ‘Study of the Electro-Magnetic Properties of the ALMA Antennas’ along with other IPTs. A design for the configuration of the innermost (within 4km) station locations was submitted August 2005 along with a strawman design for the outermost station locations. The latter will be iterated with the road and fiber

network design during the coming quarter to achieve a design which is scientifically robust while minimizing road and fiber costs.

Emerson continues to lead the planning for holography at the ATF and in Chile. The ATF holography demonstration will occur during the coming quarter. Weather stations have been removed from the site characterization containers at Chajnantor and are currently in Tucson for recalibration before being deployed at the OSF in support of holography.

A series of papers will be published in this quarter describing the testing done by the Antenna Evaluation Group on the prototype antennas.

9.3.2 Calibration

Calibration examples, illustrating aspects of the Calibration Plan, have been drafted and began a series of internal reviews during the period. These will conclude shortly. Interaction continues with the Front End Group on the specifications for the Amplitude Calibration Device.

Testing of the prototype WVRs on the SMA continued during the period. The amplitude calibration device is needed to correct for absorption of astronomical signals by the earth's atmosphere. The design was agreed on in August 2005. Due to mechanical difficulties, there have been delays. The prototype device is being built at Rutherford Appleton Laboratory. The water vapor radiometers correct for phase fluctuations caused by the atmosphere. The two prototypes (from Cambridge and Onsala) were installed on the Sub Millimeter Array in Hawaii in February 2006. Data has been taken since March 2006. So far, the results are very encouraging. More data is being taken in various weather conditions to determine the dependences of the accuracy of corrections. During October, a Workshop on Measurement of Atmospheric Water Vapour: Theory, Techniques, Astronomical and Geodetic Applications will be held in Wettzell / Hoellenstein (Germany). One goal will be to assess the tests of the prototype WVRs on the SMA.

9.3.3 Imaging

Brogan, Myers, Golap and Holdaway have continued their efforts to produce a user-friendly ALMA simulator in CASA. Myers produced a script and simulated a Sunyaev-Zeldovitch observation of a cluster observed at 3mm with ALMA.

9.3.4 Site Characterization

This activity was closed on 1 January 2006.. Characteristics of the site are monitored by the APEX and CCAT groups.

9.4 Science Requirements

The ALMA Science Requirements were approved by the ALMA Board in June 2006, pending some small changes which were made and submitted. Elucidations of these requirements were made with respect to the amplitude calibration device, the ALMA tracking rate, and the radiofrequency membrane covering the Cassegrain hole of the antenna. Requirements for the Quarter Wave Plate were also produced and discussed with the FE IPT.

9.5 Organization, Interaction with Other IPTs

Telecons and face-to-face meetings with other IPTs are held when appropriate. The Science IPT works more often than weekly with the Computing and System Engineering IPTs. Science

IPT members serve on the Science Software Requirements group of the Computing IPT. Testing of elements of ALMA software includes members of the Science IPT.

Science IPT leaders are active on the Operations Working Group, which met intensively to produce a new version of the Operations Plan during the quarter.

9.6 Meetings, Outreach, and Public Education

Special ALMA oral and poster sessions were held at the AAS meeting in June in Calgary. Presentations are available online at the NAASC web site. A workshop on Complex Molecules in Space: Present Status and Prospects with ALMA was held 8-11 May 2006, at Fuglsoecentret, near Aarhus, Denmark. About 80 participants registered; presentations are available at the conference website. This was held in conjunction with an EU Molecular Astrophysics meeting.

Meetings at which ALMA was represented include:

- Making the Most of the Great Observatories, 22-24 May 2006 Pasadena, Ca.
- The Red Rectangle, 23-25 May, Charlottesville, Virginia
- SPIE, 24-31 May, Orlando, Florida
- ALMA Special Sessions, AAS/CASCA 4-8 June, Calgary, Canada
- Coalition for National Science Funding Hill Exhibition 7 June, Rayburn House Office Building, Washington
- 61st OSU International Symposium on Molecular Spectroscopy, 19-23 June 2006, Columbus Ohio USA

Planning occurred for future meetings, including:

- The fate of gas in galaxies 12-14 July 2006 ASTRON, Dwingeloo,
- IAU XXVI General Assembly Prague, 14-25 August 2006
- Workshop on Measurement of Atmospheric Water Vapour: Theory, Techniques, Astronomical and Geodetic Applications 8-11 October Wettzell / Hoellenstein (Germany)
- Workshop on Needs for Millimeter/Submillimeter Lab Astrophysics, 19-20 October, Pasadena, Ca
- Science with the Atacama Large Millimeter Array (ALMA) II, 13-16 November; Madrid, Spain
- AAS Meeting ALMA Town Meeting, January 2007, Seattle, Washington
- Astrophysical Masers and their Environments 12-16 March 2007,, Alice Springs, Australia
- 50th anniversary of the founding of NRAO 17-21 June; Charlottesville, Virginia
- Workshop on Cool Disks in Astrophysics, 22-23 June 2007, Charlottesville, Va.

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

Concerns

The schedule for PSI pre-commissioning tests has slipped to the extent that there may be less accomplished during PSI and, consequently, more to be accomplished during Commissioning at the AOS in Chile. This could affect the assumptions used to build the Commissioning costing model.

9.8 Planned Activities for Next Period.

Commissioning – Commissioning activities will not begin until 2007, but planning has been intense. Robert Laing will refine the Commissioning and Science Verification plan to account for changes resulting from the AIVC/SV meeting in June and develop the associated staffing plan. Emerson has been intimately involved with PSI testing at the AOC. Science IPT members will participate in holography testing during the early Fall at the ATF. Participation will continue in evaluating PSI as it moves to the ATF from the AOC labs during the period.

Manpower –. T. Hunter (SMA) will be joining NRAO in November. He will work partly on ALMA. Several postdoctoral researchers will join the Science IPT during the upcoming period. In Charlottesville, R. Reid and A. Hales will arrive in September in Santiago; I. Goncalves will arrive in the Fall as an ESO/ALMA postdoc. In Garching, Silvia Leurini and Thomas Stanke will arrive as ALMA postdocs in October.

Site Characterization – Weather station redeployment at the OSF will occur.

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, the deployment of which at the SMA will cease during the period. Results will be presented at the workshop in Wettzell, Germany. Internal review of calibration examples will conclude. Calibration needs of the new DRSP2 proposals will be assessed.

Imaging – Polarization and mosaicking with multiple antenna designs will be simulated late in this quarter and into the following quarters of 2006. 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 – Production of the Biweekly Newsletter/NA continues, as does IPT participation in the ALMA EPO program. Science IPT leads will meet with other project EPO principals in a face-to-face meeting during the IAU in Prague. One item for discussion will be production of a general ALMA e-Newsletter.