National Radio Astronomy Observatory

Quarterly Report

October - December 2005

NATIONAL RADIO ASTRONOMY OBSERVATORY

Quarterly Report

October – December 2005

Cover Image: A composite of radio (Very Large Array) and optical (Lick Observatory 120-inch and Siding Spring 2.3m telescopes) images of the galaxy cluster Abell 194. This compelling image was awarded an Honorable Mention in the 2005 AUI / NRAO Image Contest. Image courtesy of Steve Croft (LLNL) et al.

Table of Contents

Executive Summary

NAASC

Work concentrated this quarter on planning the ALMA Town Hall at the January AAS meeting, and on planning the first NAASC workshop to be held in early January: "From Z-Machines to ALMA: (Sub)millimeter Spectroscopy of Galaxies". Other ALMA-related workshops are in the early planning stages. Work continued on the NAASC staffing plan. The ANASAC met once during this period.

EVLA

The EVLA work funded by the Mexican CONACyT was completed and the total Mexican funding of $1.75 M has been received. Retrofitting of the fifth EVLA antenna was started. A significant source of signal aliasing in the baseband downconverter was identified and a solution to the problem was designed and successfully tested. The new shielded chamber for the EVLA correlator was completed and successfully tested. Detailed design of the new correlator chip was completed by the Canadian design team and was released for fabrication, with delivery of prototype chips scheduled for March 2006.

Green Bank Telescope

The telescope is once again in winter, high-frequency operation, with observations up to 48 GHz being routinely undertaken. We continue to refine the ease of observation control and data analysis, with incremental improvements to both Astrid and GBTIDL.

The Ka-Band (26-40 GHz) receiver and Caltech Continuum Backend have been completed and commissioned on the telescope. The Caltech Continuum backend is working extremely well, and science observations have begun. Although the continuum performance is good, in spectral-line mode the Ka-Band receiver shows low-level baseline structure which is currently preventing high-redshift CO observations. The cause of this structure is under investigation.

In collaboration with Andy Harris (University of Maryland), NRAO work has begun to support Zpectrometer, the ultra-wideband spectrometer for the Ka-Band receiver. A face-to-face kickoff meeting was held in Green Bank in October, and both groups are making good progress.

Very Large Array & Very Long Baseline Array

Four proposals requesting 70-100 hours each were accepted for the VLA, after a special call for extragalactic blank-field proposals. The accepted proposals are expected to make excellent use of complementary data from the Hubble Space Telescope, Spitzer Space Telescope, and VLA, in order to study various aspects of galaxy evolution in the early Universe. VLA images from two large gravitational

lens surveys, including over 10,000 images, now have been made available via the National Virtual Observatory portal.

The VLBA achieved its first successful observation with Mark 5 disk-based recording systems at all 10 antenna stations. The AIPS software used for both VLA and VLBA data analysis was downloaded by nearly 1500 different IP addresses during the course of 2005, thus supporting a wide user community in approximately 40 different countries.

Central Development Laboratory

Significant progress was made in the design and test of new low-noise amplifiers and electromagnetic components for the new EVLA receivers.

The first quadrant of the ALMA correlator was completed except for European tunable filter bank cards which are still under development; all other circuit boards have been delivered and most have been tested. Development and test of ALMA Band 6 cold cartridges made good progress toward the first official delivery early in 2006. The first local oscillators for the ALMA front-ends were delivered, and all but Band 9 meet all requirements. Significant progress was made in design of the last pieces of the front-ends and of the North American Front-End Integration Center.

Development of advanced SIS mixers for frequencies above 700 GHz made good progress with the successful production of NbTiN films at the UVA Microfabrication Laboratory.

Solar activity continues to be monitored over the 20-70 MHz and 250-1000 MHz bands by GB/SRBS Phase II. Fabrication work is in progress for the 70-300 MHz band, and design work continues for extension to the full targeted 10-3000 MHz band.

Education and Public Outreach

A 2006 NRAO Calendar was produced, and the 2006 NRAO/AUI Image Contest was announced. The three NRAO exhibits were re-designed and re-built. New ALMA, EVLA, and GBT brochures were produced. Production began on a new Observatory-wide brochure targeting the general public. The Observatory issued three well-received press releases. EPO education personnel collaborated with the Society of Amateur Radio Astronomers on a $40K NASA *Ideas* Grant to fund a new NRAO outreach program called *Navigators*. EPO submitted a $7.2M proposal to the New Mexico State Legislature for the design and construction of a new Visitor and Education Center at the Very Large Array. The CY 2005 VLA Visitors Center attendance was 21,832 persons; the CY 2005 attendance at the Green Bank Science Center was 44,717 persons. More than 700 persons attended a very successful Community Open House held in Charlottesville on October 23.

Executive Summary

Administration

Fiscal Division

During this past quarter, the Fiscal Division was involved in system changes as follows: a revised chart of accounts, general ledger enhancements, upgrade of accounts receivable procedures, initiation of new accounts payable procedures, and continued work on payroll conversion which went into operation on January 1, 2006. This was accomplished while having the fiscal year end close on September 30, 2005. Also, during this period the annual audit by KPMG took place and NRAO continued to receive complimentary results.

Business Services

The table on page 49 represents NRAO Operations (without EVLA) expenses and commitments for the First Quarter 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 operations carryover that is committed, $902,208 in prior year operations carryover and $4,011,535 in Green Bank Track repair carryover. To date, $11,850,000 in new NSF funds for NRAO Operations has been received.

Environment, Safety, and Security

This quarter, in New Mexico, ES&S initiated the electrical arc flash safety program and completed the annual air emissions summary for the site. At Green Bank, the fire system links between all major site buildings were installed and are properly functioning. In Charlottesville, the NTC was inspected for potential fire and security improvements. Lastly, at all major sites, the field work for the planned environmental audit was completed. A final environmental status report is pending at this time.

Science Highlights

Very Large Array

VLA Identifies Afterglow of Short Gamma Ray Burst in an Elliptical Galaxy - The VLA was used to unambiguously identify the afterglow of the short "hard" gamma-ray burst GRB050724, using the rapid-response observing mode put in place earlier in 2005. The identification of the radio afterglow of this burst detected by the Swift satellite showed its association with an elliptical galaxy at z=0.257. The association with a galaxy that is dominated by an old stellar population provides key support for the model in which two compact stellar remnants in a binary system coalesce, giving rise to the gamma-ray burst and the relativistic fireball.

Investigators: E. Berger (Carnegie Observatories) and 23 collaborators.

Very Long Baseline Array

VLBA Measures Distance to Perseus Spiral Arm - Using the VLBA, a team of researchers has precisely measured the distance to the Milky Way's Perseus spiral arm. They observed strong methanol masers in the W3OH star-forming region, measuring the trigonometric parallax of those masers. Their direct measurement of 1.95 ± 0.04 Kpc resolves a previous factor-of-two discrepancy in the distance to the Perseus spiral arm. The discrepancy arose because of anomalous motions in that part of the Perseus arm. This result, which indicates that the VLBA can measure distances out to 10 Kpc with accuracy 100 times better than the Hipparcos satellite, can lead the way to mapping the spiral structure and full kinematics of massive star-forming regions in the Milky Way.

Investigators: Y. Xu (Nanjing), M.J. Reid (CfA), X.W. Zheng (Nanjing), and K.M. Menten (MPIfR, Bonn).

Green Bank

GBT Measurements of the Zeeman Effect - Robishaw and Heiles have used the GBT to observe the 21-cm line along two strips across the major axis of a molecular filament in the Orion molecular cloud. They detected significant Zeeman splitting at almost every position and find that the line-of-sight magnetic field reverses direction across the axis of the molecular cloud (Figure 1). These observations are consistent with lower-resolution detections made using the Hat Creek 85-ft telescope. Stellar polarization data show that the plane-of-sky field is nearly perpendicular to the cloud's major axis; this, in addition to the opposite directions of the line-of-sight fields above and below the cloud, suggests a helical magnetic field structure. MHD simulations of filamentary molecular clouds have been able to reproduce just such a helical magnetic field structure. The line-of-sight field strengths in this region are at least 10 microGauss, corresponding to a pressure of at least 30,000 K/cm^3; this is comparable to the pressure from the hot gas that permeates the Eridanus loop. A long-standing theoretical construct maintains that high-

mass star formation is moderated by magnetic fields: regions of massive star formation should possess low fields in order for gravitational instabilities to dominate. However, observations, including these GBT results, have shown just the opposite. The Taurus molecular clouds are devoid of high-mass star formation yet exhibit upper limits on magnetic field strengths of less than 8 microGauss. In Orion, a site of high-mass star formation, line-of-sight fields larger than 10 microGauss in emission were found throughout the region.

Investigators: T. Robishaw, C. Heiles (UC Berkeley).

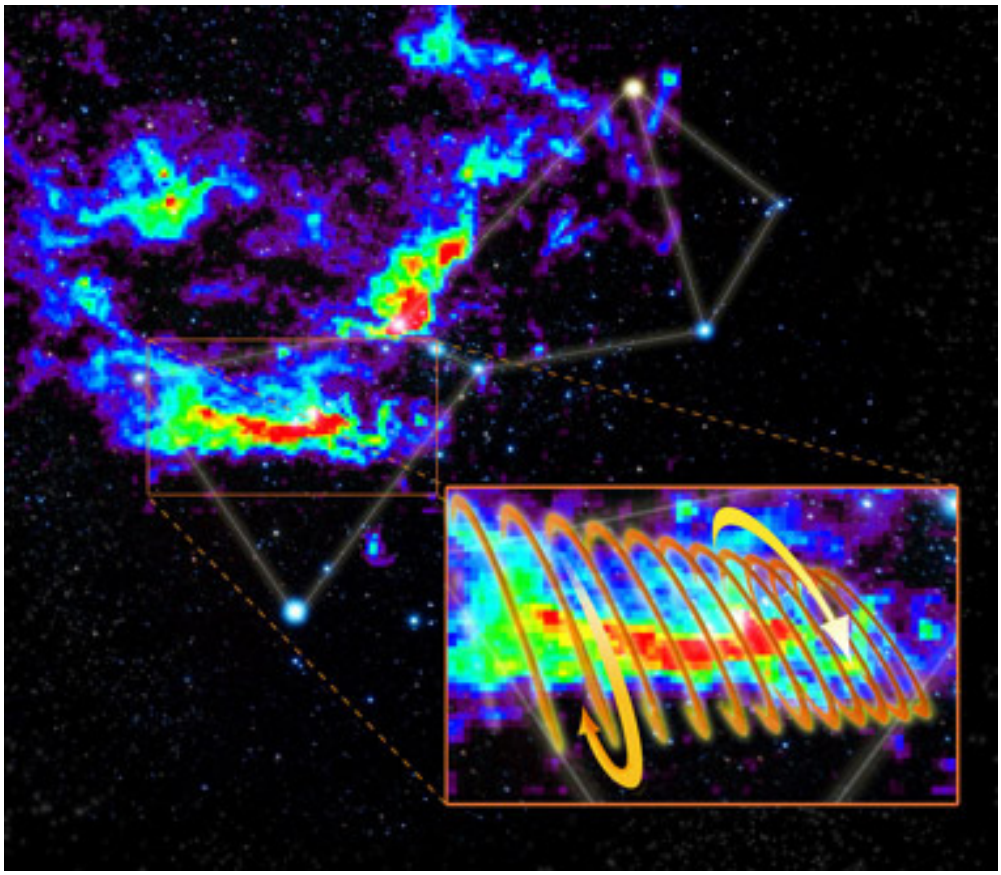


Figure 1. The Orion Molecular Cloud superimposed on the Orion constellation, with the orange star Betelgeuse at the top center. The inset shows the Slinky-like coils of the helical magnetic field surrounding the filamentary cloud. (Credit: Saxton, Dame, Hartmann, Thaddeus; NRAO/AUI/NSF)

North American ALMA Science Center Highlights

Work concentrated this quarter on planning the ALMA Town Meeting at the January AAS meeting, and on planning the first NAASC workshop to be held in early January: "From z-Machines to ALMA: (Sub)millimeter Spectroscopy of Galaxies". Other ALMA-related workshops are in the early planning stages. Work continued on the NAASC staffing plan. The ANASAC met once during this period.

North American ALMA Science Center

The NAASC staff met with interested parties every two weeks during this quarter to discuss progress and to plan the presentation for the ALMA Town Meeting scheduled for the first day of the 207th meeting of the AAS in Washington, D.C. The NRAO ALMA brochure and display booth were revised for this meeting. The 2006 summer meeting of the AAS will be held in Calgary, Canada, with the first day a joint meeting with the Canadian Astronomical Society (CASCA). Planning has begun with colleagues in Canada for a special ALMA session on the overlap day. A proposal for this special session has been submitted to the AAS.

A two-day workshop for ~70 participants will be held on the topic "From z-Machines to ALMA: (Sub)millimeter Spectroscopy of Galaxies", in Charlottesville, January 12-13, 2006. This will be the first of what we expect to be yearly NAASC workshops. The scientific organizing committee completed its work on the program during this quarter. The ASP was contracted to publish the workshop proceedings. The local organizing committee held regular meetings, reviewing and checking the myriad of details that make for a well-organized meeting. More information can be found *http://zmachines.net*. Workshops being considered for the future include joint workshops with the Herschel and James Webb Space Telescope missions.

Work on the NAASC staffing plan and Operations budget projections for FY2006-2012 continued through several in-house meetings. The first was held in Charlottesville on November 15, 2005 between the NAASC staff and members of the ALMA Computing IPT (Brian Glendenning & Debra Shepherd). Computing requirements for the NAASC were further defined. The second was held via videoconference between members of the ALMA Science IPT (Wootten, Mangum, Holdaway & Myers) and the ANASAC and ASAC (Carilli, Brogan), and the NAASC staff on December 7, 2005. These meetings affirmed that the draft NAASC staffing plan was fairly close to what was needed, with only minor changes required. These suggestions will be incorporated in a new and more detailed version of the staffing plan in 2006 Q1, which in turn will be used as the basis for presentations at the North American ALMA Delta Cost Review in late January 2006.

NAASC

Members of the NAASC met with the ALMA Computing IPT Observing Tool (OT) development team in November to exchange information regarding the implementation of ALMA science preparation tools for spectral line observations. The ALMA OT is a general-purpose user interface that will allow ALMA observers to prepare "scheduling blocks" which will be used by the ALMA scheduler to conduct observer science projects. Within the ALMA OT there exists the capability to display spectral line information within adjustable correlator and receiver configurations. The NAASC has been working on the development of a spectral line database that can be used as input to the ALMA OT correlator/receiver configuration tool. It was agreed that the NAASC would continue to develop the content of the spectral line database for the ALMA Computing OT development team. We anticipate that a first version of the NAASC spectral line database will be incorporated into the next development version of the ALMA OT.

The ALMA North American Science Advisory Committee (ANASAC) met once during this quarter, in a telecon on October 18, 2005. This meeting included a detailed briefing by the NRAO Director on the ALMA Cost Review. Plans for the January 2006 AAS ALMA Town Meeting were also discussed.

Expanded Very Large Array

Expanded Very Large Array (EVLA) Highlights

The EVLA work funded by the Mexican CONACyT was completed and the total Mexican funding of $1.75 M has been received. Retrofitting of the fifth EVLA antenna was started. A significant source of signal aliasing in the baseband down converter was identified and a solution to the problem was designed and successfully tested. The new shielded chamber for the EVLA correlator was completed and successfully tested. Detailed design of the new correlator chip was completed by the Canadian design team and was released for fabrication, with delivery of prototype chips scheduled for March, 2006.

Expanded Very Large Array Milestones

Milestones	Original Date	Revised Date	Date Completed
Delivery of electronics for two EVLA antennas to CONACyT	10/14/05		10/14/05
Production of 3rd cryogenics compressor completed	10/14/05		10/14/05
Balance the amplitude bandpass response	10/17/05		10/17/05
New correlator shielded room Electro Static Discharge plan completed	10/24/05		10/24/05
Hardware acceptance tests on Antenna 14 complete	08/30/05	10/12/05	10/28/05
3-bit sampler proposal due from consultant	10/07/05		10/28/05
Implement electronics hardware alarms in the checker software	11/14/05		10/31/05
Antenna 14 turnover to Operations	09/01/05	10/14/05	11/01/05
Train the VLA operators on electronics hardware alarms	12/15/05		11/09/05
Implement support for severity list in checker	12/05/05		11/14/05
*Q-Band receiver installed on Antenna 16	10/15/05		11/16/05
Final severity list for module alarms	10/31/05		11/17/05
Assemble RFI shell of new correlator shielded room	12/15/05		11/28/05
RFI tests of new correlator shielded room	12/15/05		12/1//05
WBS cost data update	11/18/05		12/02/05
WBS schedule updated	12/09/05		12/05/05
L301 module RFI test on EVLA antennas	12/13/05		12/13/05
Move Antenna 24 into AAB – start EVLA outfitting	11/01/05		12/15/05

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
Wideband L-Band receiver dewar parts fabricated	12/15/05		12/15/05
Hardware acceptance tests on Antenna 16 complete	07/27/05	10/05/05	12/22/05
Antenna 16 turnover to Operations	07/28/05	01/10/06	
First fringes at X-Band on Antenna 13	01/10/06		
M302 design complete w/ test fixture	11/07/05	01/13/06	
Telcal component fundamentally finished	11/30/05	01/16/06	
Requirements for final version of Observation Executor complete	07/14/05	01/17/06	
VLA antenna setup w/ Observation Executor	10/14/05	01/17/06	
Specify extensions to EVLA script and obs2script	10/17/05	01/17/06	
L-Band wideband receiver assembled	09/23/05	01/20/06	
Feed moisture filtration prototype installed	01/25/06		
4 IF's on Antenna 13 working	11/10/05	01/25/06	
Hardware acceptance tests on Antenna 13 complete	09/28/05	01/27/06	
Two F317 modules w/ MIB tested and ready for software	09/08/04	01/27/06	
Check for interference and bandpass shapes: 8, 22 & 45 GHz – written report	03/15/04	01/30/06	
Receiver stability tests: 8, 22 and 45 GHz	12/19/03	01/30/06	
Report on Receiver stability, bandpass shapes, linearity of RF design	08/12/05	01/30/06	
New VLA correlator controller operational, controlled from Modcomps	08/30/05	01/31/06	
Reference pointing observing with EVLA antennas	01/31/06		
L353 Module MIB ICD ready for software development	01/31/06		
1.5 GHz wideband receiver lab test complete	02/03/06		
Start transition mode observing	03/15/05	02/06/06	
M301 module ready to install on antenna	06/08/05	02/16/06	
RTP data multicast from L352, w/ listener thread in interim Observation Executor	07/29/05	02/20/06	
4/P converter w/M301 ready for use	10/14/05	02/21/06	
4 IF's on Antenna 18 working	12/13/05	02/21/06	
Final version of antenna VOIP phone	10/31/05	02/28/06	
Project book updated	02/28/06		
Central LO-rack (21-28) ready for use	02/15/06		

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
Decision made on 3-bit sampler design	02/15/06		
Total power detector added to baseband converter	02/15/06		
Hardware acceptance tests complete on Antenna 18	02/23/06		
Antenna 18 turnover to Operation	02/28/06		
L302 module firmware updated and tested	02/28/06		
Utility module (M302) prototype installed	03/01/06		
New VLA correlator controller controlled from EVLA M&C system	11/30/05	03/01/06	
Front Ends CDR	05/05/05	03/09/06	
Archive records written using Modcomp independent format	03/13/06		
Agreement on common project software model	09/01/05	03/15/06	
Preliminary on-the-sky test plan completed	11/30/05	03/15/06	
First correlator chip prototype delivered	11/28/05	03/31/06	
Complete Part 2 hardware bench integration	03/03/03	04/03/06	

Project Management

The final delivery for EVLA equipment funded by the Mexican CONACyT was completed. Assembly of two antennas of electronics hardware were completed and presented to Mexican UNAM representatives visiting the VLA on November 9. The total Mexican funding of $1.746 M was received.

The project made changes to its chart of accounts to take advantage of the newly revised fiscal reporting system. The account changes will allow more resolution of cost and effort spent on all level 4 WBS tasks. Level 2 WBS cost and schedule reviews were held and the project WBS was updated.

Systems Integration

EVLA Antennas 14 and 16 are now functioning with four complete IF's, all using the new digitizer design. These antennas are being used by the scientific and technical staff to evaluate the performance of the EVLA hardware and software. Current testing is focusing on the phase noise and amplitude stability of the electronics hardware in an attempt to determine the cause of a few tens of percent loss of expected sensitivity. A prototype bandpass filter was installed in the T304/5 baseband down converter in Antenna 16. This change eliminated an aliasing problem and improved the overall sensitivity. The reliability of the antennas has been improved by adding a phasing feature to the data transmission modules. In addition, we now have sufficient modules to repopulate the test racks in the Array Operations Center (AOC). They are being used to evaluate performance as well.

Expanded Very Large Array

Progress is continuing on the outfitting of the third and fourth EVLA antennas (Antennas 13 and 18) with EVLA hardware. Antenna 13 outfitting is essentially finished and is awaiting a complete set of tested modules. Racks were installed in Antenna 18 in early December.

Civil Construction

The RFI Shielded Room erection was completed by December 9, 2005. The Shielded Room was successfully tested for RFI leakage per the room specification by December 14, 2005. The completed room was also given an Integrity Test, checking for room tightness, which is required as part of the Fire Suppression contract on December 20, 2005.

The fire suppression system contract was started in November 2005. The plan is to complete the work early in the second quarter of 2006. Request for Quotation (RFQs) for computer flooring, under floor liner, pre-action sprinkler system materials, power distribution equipment and correlator support frame materials were received and committed to in November and December 2005. As with the fire suppression system, these systems and work will also be completed in the second quarter of 2006.

The RFQ for HVAC equipment was received in December 2005 and will be committed in early January 2006. An RFQ for HVAC equipment plumbing will be issued during the first quarter of 2006.

Antennas

While electronics technical problems were being resolved on the EVLA test antennas, the mechanical group performed two regular VLA overhauls. Some EVLA designed installations (those not affecting continued VLA operation) were added. Assembly of several EVLA designed sub-assemblies were completed during the period including feed cone #5 for installation on Antenna 24. Production quantities of feed mounting towers are on order. The outfitting of Antenna 24, the fifth EVLA antenna, has begun.

Front End

The second EVLA Q-Band receiver was installed on Antenna 16 in November. Once the delays and pointing offsets were optimized, fringes were successfully found. Both Antenna 14 and 16 now have a full suite of (interim) receivers, including P-Band front-ends. Efficiency measurements at K and Q-Band were completed on Antenna 14 and were found to satisfy the EVLA Project Book specifications.

The L and X-Band receivers on Antenna 13 have been cooled and are ready for fringe tests, which are planned for the second week of 2005. The K-Band receiver has been installed but is awaiting the UX-Converter before being cooled down. One of the two required Q-Band MMIC-based post-amps has been successfully checked out, and the other is being assembled at the AOC. These will be used to upgrade an existing VLA Q-Band receiver prior to installation on Antenna 13 early in 2006.

Expanded Very Large Array

The FE-Rack has been installed on Antenna 18, as have the X and K-Band receivers. The L-Band receiver was modified with EVLA-style 1-2 GHz balanced amplifiers but was held back to allow us to measure the effects on sensitivity and ellipticity from the honeycomb material intended for use as the vacuum window in the new EVLA 1-2 GHz receivers. This receiver will be installed on Antenna 18 in January. The C-Band receiver is in the lab undergoing final integration and RF performance tests.

Antenna 24 was stripped of its old A and F-Racks and all of the old VLA-style receivers have been removed. Sufficient EVLA Card Cages are being assembled for use on all of the receivers that will be installed on this antenna, along with the new F317 EVLA Receiver Monitor & Control module, in the first quarter of 2006.

The machined dewar components for the prototype L-Band receiver were delivered on schedule in December and assembly of this new-generation EVLA-compliant receiver is underway. Vacuum and thermal capacity tests will be carried out early in 2006 followed by RF performance tests on the cooled 1-2 GHz Lilie OMT.

Local Oscillator

The L305/L350 mother boards had their final respin completed, and we have ordered the final production quantity. The L352/L353 modules are undergoing changes to simplify the designs and solve some minor issues. The Miteq modules have been trickling in allowing synthesizers to be completed at a slow but acceptable rate.

Fiber Optics

The Digital Transmission System (DTS) modules had their firmware upgraded during the quarter to increase the reliability of their power-up protocol. Additional firmware updates and retrofits of some parts are scheduled for next quarter.

Antenna 18 is nearly completely outfitted with fiber optic cable. Everything outside the vertex room is finished and the Ethernet switch has been mounted. The remainder of the fiber cables in the vertex room will be installed after the LO/FE racks are installed. The fiber infrastructure is proceeding well. The fiber to every antenna pad has been tested and its losses documented.

Intermediate Frequency

The 4P converter was found to have some image problems due to an incorrectly specified filter. New filters have been purchased but the boards will have to be respun due to the new filter size. Almost half of the production UX converter plates have been received and we are waiting for housings to complete the assemblies. The T304/305 had some aliasing problems and is now in need of a respin. The layout for the respin is underway and the current units have been modified to alleviate the problem.

Expanded Very Large Array

Correlator

Completion of design work on the EVLA correlator was delayed somewhat due to problems with software tools, and due to the need to incorporate changes for manufacturability and long-lifetime that have been determined through extensive meetings and consultations with our PCB and board assembly manufacturer. Signing of the contract with this manufacturer is imminent. On the large Baseline Board, we ran into memory limitation problems with Windows, and it took some weeks to port the design to Linux. This board has 28 layers, with over 11,000 components, 120,000 solder connections, and all interconnected with 90 μm wires. The contract manufacturer indicates that it will be the most complex board ever built by them, and furthermore that the PCB has so many holes that each one will be on the drill machine for about 6 hours. From December 16-21, a detailed critical review of the board was held, and the minor design modifications required will likely delay completion of the design until the end of January.

Development on the large Station Board is expected to continue until the end of January as well. On December 22, testing and verification of the correlator chip design was complete, and the 4 million gate, 130 nm chip was signed-off for silicon fabrication at TSMC starting in January, with delivery of chips expected by the end of March.

Software development continues to catch up, and with the assistance of excellent work from NRAO software engineers, it is likely that software will be in place for first prototypes of the large boards, expected in early April.

A re-baselining of the correlator budget based on preliminary, but reasonably accurate, pricing from our contract manufacturer indicates that we are well within budget with adequate contingency. Our schedule still appears to be on track for the schedule indicated in the last report, however it should be noted that as we move into prototype testing, the error bars on any schedule are of unknown amplitude. As such we are doing everything possible to ensure correctness of design as early as possible, to mitigate uncertainty.

Monitor & Control

During Q4 2005, there have been two new releases of the User Interface software, and VLA operators have been trained in its use. A severity list of alarms for EVLA antennas has been developed. The device browser can now be used to modify all writable attributes of monitor points and can plot multiple monitor points in real-time. The observing level software (obs2script, the Executor, interim Telcal, interim DCAF, etc.) continue to develop and mature.

The WIDAR correlator prototype station and baseline boards are now expected around April 1, 2006, and the prototype correlator chips are due in mid to late March 2006. The software needed to support testing of the correlator prototypes is on schedule.

Expanded Very Large Array

Testing of the correlator controller continued, with new scientific tests, both in line and continuum, in December. Results are being analyzed and new tests are planned for January.

Data Management

During the ADASS meeting in October representatives of ALMA, the GBT, and the EVLA agreed on a timeline to come to agreement on Project and Science Data Models. In the meantime, more pressing commitments have forced us to delay this timeline. To address the delay, a meeting between EVLA, ALMA, and GBT personnel will be held in Edinburgh in April 2006 to refine, and hopefully agree on, the observer's Project Data Model. Additional objectives of the meeting include ALMA's adoption of the EVLA Proposal Tool and EVLA's adoption of the ALMA Observation Preparation Tool. The suitability of ALMA's Science Data Model for the EVLA will be evaluated over the next few months with EVLA-like data produced by the VLBA.

The new proposal tool will be used for the first time for the February 1, 2006 VLA deadline, and for the third consecutive time for the GBT. A new hire in one of the e2e positions has allowed us to start work on Web applications frameworks in general and the observation preparation tool in particular. The VLA/VLBA archive will start using ALMA's NGAS storage technology.

Green Bank Telescope

Green Bank Telescope (GBT) Highlights

The telescope is once again in winter, high-frequency operation, with observations up to 48 GHz being routinely undertaken. We continue to refine the ease of observation control and data analysis, with incremental improvements to both Astrid and GBTIDL.

The Ka-Band (26-40 GHz) receiver and Caltech Continuum Backend have been completed and commissioned on the telescope. The Caltech Continuum backend is working extremely well, and science observations have begun. Although the continuum performance is good, in spectral-line mode the Ka-Band receiver shows low-level baseline structure which is currently preventing high-redshift CO observations. The cause of this structure is under investigation.

In collaboration with Andy Harris (University of Maryland), NRAO work has begun to support Zpectrometer, the ultra-wideband spectrometer for the Ka-Band receiver. A face-to-face kickoff meeting was held in Green Bank in October, and both groups are making good progress.

GBT Milestones

GBT Antenna & Operations (Azimuth Track Project)

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

GBT Electronics

Milestones	Original Deadline	Revised Deadline	Date Completed
Spectrometer Upgrades			
LTA Test and Debug	04/15/05	On Hold	

Green Bank Telescope

Milestones	Original Deadline	Revised Deadline	Date Completed
RFI Improvements			
Finish GBT receiver room HVAC suppression	12/01/03	On Hold	

GBT Mechanical Engineering & Central Shop

Milestones	Original Deadline	Revised Deadline	Date Completed
GBT RFI Antenna Mount Design	10/29/04		12/31/05
GBT RFI Antenna Mount Fabrication	04/14/06		
Test Building Receiver Handler	10/15/04	01/1/06	12/09/05
EVLA X-Band Feed Towers (2)	10/31/05		10/06/05
EVLA L-Band Feed Assemblies (3)	10/31/05		12/13/05
Solar Burst Antenna	04/14/06		
ALMA Cartridge Extender Suite	03/31/06		

GBT Software & Computing

Milestones	Original Deadline	Revised Deadline	Date Completed
Integrate GFM/IDL; Deprecate IARDS	03/31/04	2/15/06	
Integrate Pulsar Modes into Astrid	12/31/05		11/15/05
Eliminate Backlog of Software Maintenance Requests	12/31/05		12/14/05

GBT Projects

Milestones	Original Deadline	Revised Deadline	Date Completed
PTCS			
Identify 1" level contributors to pointing error	09/30/04	project on hold	
Ready for prototype W-Band operation under benign conditions	10/01/04	project on hold	
Ease of Use			
Complete "Phase 4" of Observing API (near-earth objects, source catalogs)	06/30/05		10/15/05

Green Bank Telescope

Milestones	Original Deadline	Revised Deadline	Date Completed
Data Handling			
Generate requirements for imaging	12/31/03	12/01/06	
First draft of GBT Science Data Model	03/31/05	12/31/05	11/15/05
Ka Band (1cm Rx)			
Develop LO Distribution Module	6/01/05	07/15/05	07/15/05
Refurbish Receiver	08/04/05		09/30/05
Install on GBT	10/03/05		11/01/05
Penn Array Receiver			
Detectors Delivered to Penn	5/17/04		12/2005
Full Lab integration at Penn	9/6/04	2/2006	
GBT Commissioning	2/21/05	4/2006	
3mm Receiver			
Design/Fab Cryostat	11/10/05	04/01/06	
Final Receiver Assembled	02/01/06	06/01/06	
Caltech Continuum Backend			
Construction and lab testing complete	08/27/04	11/2005	11/2005
Commission on GBT	09/06/04	12/2005	12/2005
Zpectrometer			
Installed on GBT	10/01/06	10/01/06	
Science validation complete	05/31/07	05/31/07	

Azimuth Track

Formal requests for quotations for new base plates and wear strips closed during this period, and negotiations on specifications, work sequencing and other aspects continued for most of the quarter. Official quotations were higher than the original estimates provided by vendors. Energy and material cost increases were cited as important drivers in the cost increases. RFQs for installation work and fasteners will close in January 2006. A determination will be made at that time as to how to proceed with the project.

Telescope Operations Activities

The Telescope Operations Division has been busy with support of three operating telescopes: the GBT, the 43m project for MIT/Lincoln Laboratory, and the 45ft solar project. The telescopes are working well. The automated pulsar survey using the 85-3 dish also continues with little support. Maintenance activities on the GBT have scaled back to preventive maintenance activities for the cold weather, high

frequency observing season. Some preparations have begun to support the azimuth track replacement project. These preparations consist of the erection of reference monuments for the alignment of the plates.

Green Bank Electronics

Green Bank Electronics provides support for all electronic systems at Green Bank, including telescope controls, backends, RF equipment, audio-visual equipment, network installation and maintenance, radio system work, and even machine shop electronic repair. Some specific activities of the three Groups are reported below.

Digital Group

Most of the Digital Group's time was spent on 45ft and 43m Servo support, and the Caltech Continuum Backend project. Green Bank Electronics has assumed responsibility for production of the ALMA Front-end Bias Module, which required a large fraction of an FTE this quarter.

The 45ft servo system work for this quarter consisted of construction of the new servo system for the telescope. The new system will be installed this spring. The antenna is in daily operation with the old servo system providing motion.

The new motion control system for the 43m telescope was designed, built, installed, and tested. The antenna is in routine operation. Development work for making the antenna capable of remote operations is underway. The upgrade will be installed in February.

During this quarter, spectrometer development was on hold. LTA work will continue starting in February.

The Digital Group also supplied engineering to assist the Caltech Continuum Backend project. The first article was completed and tested this quarter. It has been tested on the telescope, and is working well. We will build the rest of the backends in the first quarter of 2006.

Microwave Group

The Microwave Group provides support for the GBT receivers, IF/LO systems, and the site radio, intercom, and GBT phone systems.

The 26-40 GHz receiver was removed from the telescope over the summer, and modifications to bring it up to its full complement of spectral channels and continuum detectors were completed. The receiver was integrated with the Caltech Continuum Backend before being reinstalled in October. Some additional work was done in November and December to adjust the power levels across the band, and to

try to flatten out the baselines. There remain some baseline problems which will be addressed during 2006.

The IF system received some attention this quarter. New IF amplifiers are being built and tested. Various module instabilities and failures were repaired, and investigations continue to improve gain stability, with better temperature control and other steps such as adding isolation amplifiers to the optical receiver module splitters.

The Microwave Group is supplying expertise to the 43m MIT/LL telescope project. There is a need for a tunable IF system to allow use of existing backends with the wideband feed MIT/LL installed on the antenna, in order to do pointing checks, and to look for satellite beacons in the RF.

Development of a 68-92 GHz correlation receiver continues. This project will be lowered in priority in the first quarter of 2006 to allow more engineering expertise to be applied to other GBT projects, since the antenna's PTCS is behind schedule.

RFI Management

The RFI group provides Observer Support, NRQZ Administration, and on-site and off-site RFI Mitigation.

In Q4, the NRQZ administrator processed 53 regular applications, and 18 preliminary applications. ERPd restrictions were placed on three sites. There were no site inspections. A Propagation Model Measurement Campaign Meeting was held on December 20, 2005. Paulette Woody was hired as the new NRQZ Administrator in October 2005, and Carla Beaudet was appointed to the group leader of the EMI/RFI group in December 2005.

The group investigated RFI reports in PF1, X-Band, Ka-Band, and in SRBS data. Several problems with power line RFI were identified and fixed. Wireless networks in the area are being identified and mitigated. A Public Relations Campaign is being developed to promote RFI awareness and to “soften the blow” when we request compliance. Numerous devices were tested in the Anechoic Chamber. Shutoff deadlines have been imposed on the SRBS and the EOR projects, and mitigation efforts are being expedited and supported. Mitigation efforts for the MIT/LL project are also being coordinated and supported. Plans to include our RFI policies in the MOU's for future projects are in the works.

An IPG Policy has been developed for Zones 1 – 5 in the NRQZ; the policy has been approved by the Site Director, the NRAO Spectrum Manager, and NRAO Spectrum Management attorney.

Green Bank Telescope

Mechanical Engineering and Central Instrument Shop

During the last quarter of 2005 the design for an RFI monitoring station to be placed at the top of the GBT feed arm was nearly completed. This is a damped, self-righting system that will hold five monitoring antennas. Two of these antennas can be rotated about two axes.

The Central Instrument Shop completed the first of several orders for EVLA mounts and feeds. ALMA work included devising manufacturing processes for receiver bias boxes, and for a number of receiver cartridge extenders. Production work on these items will take place through the first quarter of 2006 and possibly into the second quarter. Next quarter will also see completion of the GBT RFI monitoring station fabrication and the start of work to upgrade the GBT Q-Band receiver.

Software Development Division (SDD)

The primary SDD accomplishments in Q4 2005 were: (a) the release of v5.7 of the GBT control software; (b) the release of GBTIDL v1.2 with robust basic continuum functionality; (c) a complete restructuring of the framework for the GBT real time data display to successfully display large spectral line datasets; and (d) standardization of the GBT source catalog format. Continued support was also provided for Scheduling Block based observing using the Astronomer's Integrated Desktop (Astrid) and commissioning-related activities for the Caltech Continuum Backend, Ka-Band receiver, and Penn Array.

The SDD produced one regular release of its key product, M&C, with v5.7 on November 16, 2005. In this release, changes were made to allow the use of dynamic focus corrections and dynamic pointing corrections independently, under observer control. Additional changes were made to reduce the number of trajectory generation failures; now, a message is asserted when additional slew time is required to prevent the failure. In the past, the M&C system typically generated irrelevant error messages, e.g., poor LO power levels from receivers or missing inputs to backend, because much of the control software did not know which devices are currently participating in a scan. This was especially evident for backends because missing inputs were reported where none were needed. As of v5.7, this behavior does not occur. Configuration now also supports multiple backend configurations for pulsar observations in one configuration keyword. For example, backend = 'GASP/CGSR2/SPIGOT' specified as a configuration parameter in your Scheduling Block will result in the configuration of 3 backends, GASP, CGSR2 and the SPIGOT.

Commissioning the Ka-Band Receiver and Caltech Continuum Backend, and spring engineering tests for the Penn Array continue to be key priorities of the GBT and for software support over the upcoming months. Many incremental software changes were made as a result of CCB testing, such as adding configurable choices for mappings to control the cal diode firing pattern. Substantial work has also been done with the Penn Array test installation and its control software over the past quarter such as experimentally modifying FITS formats, adding new mapping mechanisms, and automating the startup of the FITS archiver for lab use.

Green Bank Telescope

Most of the work done on the observing systems software, accessible through Astrid, was behind the scenes this quarter. The driving factor behind this reengineering work was speed: to display a typical spectrometer dataset instantaneously, and support viewing integration by integration, the performance had to be improved by 100%-1600% for typical usage scenarios. The infrastructure for data access and plotting was significantly revised to successfully meet these performance requirements; the data display uses matplotlib instead of PGPLOT to accomplish this. The new developments were handed over to the Observing Issues Group (OIG) for internal testing by astronomers starting November 30, 2005. These independent tests continued through December, and the OIG will decide at their meeting on January 25 when to transition the new technology to visiting observers.

The source catalog format was streamlined this quarter. Prior to this time, each software application's developer invented a source catalog format (e.g. Condon's calfind, CLEO Scheduler & Skyview, Astrid Auto* Scan Types). The use of one standard was desired, however, so applications could share source catalogs and users need to understand only one definition. In November, the source catalog format expected by Astrid's Auto* Scan Types was adjusted from the calfind format to the standardized format. Any deviations from these specifications raises an exception and generates the appropriate message. An example of the standardized catalog format is found in Section 4 of *http://wiki.gb.nrao.edu/bin/view/Software/ModificationRequest10C705*.

The primary activity for the Data Handling project in Q4 was releasing GBTIDL v1.2 on November 28, and finalizing requirements and starting development on GBTIDL v2. Version 1.2 was built for IDL version 6.2 and includes significantly updated help features and persistent command-line history buffers. Spectral line and basic continuum data are now supported; the user can toggle between the two using the line and cont commands. Scans can be uniquely identified by timestamp. Three new functions have been added for convolving and resampling spectra. New optional histogram-style plots in the plotter are accessible via the histogram procedure, IEEE Not-A-Number (NaN) values in data are now properly handled, and automatic weighting in accum and ave takes into account frequency resolution. Version 2, which will include full flagging and blanking as well as specific enhancements requested by users, and a follow-up release with calibration tools are planned for 2006. Future versions of GBTIDL will be scheduled on as as-needed basis depending upon the volume and utility of requests from users applying a collaborative development model in which most of the additions will come from staff scientists and outside observers. Also, there is now a proven path for GBT data to be transported into AIPS for imaging.

GBT currently produces data for consumption by GBTIDL in SDFITS format. Though dedicated work on SDFITS is planned for spring 2006, enhancements were made this quarter to be able to distinguish between duplicate scan numbers when multiple files are accessed for processing and to support blanking for non-recoverable hardware failures. Due to some critical refactoring of base classes, the performance of the SDFITS generator was also enhanced, and version 1.3 now performs two-to-five times faster than previous versions, depending on the data types being processed.

Green Bank Telescope

To continue accomplishing GBT goals, the current SDD staffing vacancies must be filled, and adoption of technologies from other telescopes should be pursued. The process of recruiting for the staffing vacancies has been started.

Increased Observatory-wide coordination has been a management focus this quarter, in response to the NSF Software Review held last quarter. As mentioned in the Q3 2005 report, SDD had planned on starting a collaboration with the EVLA in Q4 to exchange ideas (and possibly design and/or code) on scheduling block execution. Meetings have also been planned for January to firm up plans for further EVLA/GBT software coordination, and to determine how to align GBT single dish data analysis work more effectively with ALMA single dish work.

Computing

This quarter Pam Ford joined the division as a junior systems administrator, taking over the administration of the Green Bank Wiki.

The Redhat Enterprise Linux upgrade program is continuing and we now have nearly all machines upgraded. The exceptions are those machines that are required for telescope operations and software development.

Green Bank computing personnel also spent some time this quarter developing and testing a system for mitigating the ever growing spam email problem. This has proved to be very successful, providing practically all the functionality of a commercial product that was previously evaluated and rejected on grounds of complexity. This quarantine system will be rolled out Observatory-wide early in Q1 2006.

Network improvements continued this quarter. New fiber trunks were installed in the Jansky Lab which will allow greater flexibility in routing. The machine shop and the cable building link were upgraded from 10Mbit to 100Mbit. The link to the 43m telescope was also upgraded from 10Mbit to 100Mbit to support the MIT/LL project. A new core switch for GB has been delivered and is now being configured by CV network staff for deployment later in 2006.

Work has also been undertaken in support of the ESS/ETK projects, deploying a number of kiosk machines around the Observatory. These will allow those staff who do not normally use a computer in their work to access these services.

Penn Array

The final series array was installed to the receiver and tested; multiple bias curves on this series array look very good. A preliminary detector array was delivered to the University of Pennsylvania (Penn) and placed into the receiver. This marked the first time that the receiver has been fully integrated in the lab and is a significant milestone. Most of the quarter at Penn was spent testing and debugging the

receiver electronics and detectors. The preliminary detector array showed less robustness than desired. Several wirebonds and detector legs were lost over time and NASA is working on a solution to this problem. The Green Bank software division delivered its IRC-based FITS archiver to UPenn and worked on several improvements to it (supporting new data formats, debugging the underlying IRC, and adding instrument configuration information to the FITS files). Following up on the September GBT/PAR fit check, tests of the purity of the gas in the GBT helium compressor lines showed significant molecular hydrogen contamination that is not frozen out by GBT receivers' 15 K cold heads; we plan to cold trap a line prior to the Penn Array installation. The project aims for an on-sky engineering run in spring 2006.

New Receivers and Backends

After an LO mixer upgrade and completion of the 16 direct-RF continuum channels for the Caltech Continuum Backend, the Ka-Band receiver was installed on the GBT for recommissioning. Significant nonlinearity was seen in early tests, which was solved by reducing the power levels at the input to the third-stage RF amplifiers. Baseline problems persist and are being investigated.

The Caltech Continuum Backend passed lab testing and was installed on the GBT in early November 2005. Commissioning and checkout activities lasted through the end of the year. Unexpectedly long transients associated with beam switch transitions in the receiver limited beamswitching rates to ~4 kHz (with 24% loss of data due to blanking). This problem was traced to the beam switch driver circuit and a fix is being designed that will enable less blanking and faster beamswitching. In each of the 16 CCB input channels an on-sky RMS of ~0.5 mJy is achieved in two minutes. Observations with the CCB have gone smoothly and work has proceeded to problems endemic to deep single-dish radiometry such as limiting the impact of differential ground spillover. Construction of the remaining CCB's (a spare; a benchtop unit; and a unit for the future 68-92 GHz receiver) will be completed in the first quarter 2006.

Spectrometers and Pulsar Backends

The GBT spectrometer cross-polarization modes have been through astronomical tests and documentation describing the best use of these modes should be delivered by the end of January 2006. All software work for release of the cross-polarization modes is now complete and tested, including: integration of the modes into the config tool, conversion of all observing modes needed expressly for polarization into astrid scripts; and integration of the cross-polarization data into both SDFITS and GBTIDL. (Note that as planned no GBTIDL routines have been written by GBT staff for data reduction with the cross-polarization modes.)

Due to the resignation of one of the engineering staff, work on the new LTA boards for the spectrometer is on hold until spring 2006.

Correlator work for the Zpectrometer is on track. The full complement of seventy correlator boards have been delivered to the University of Maryland, with acceptable spot tests for performance and

noise. Most of the correlator microwave components are in hand, and the multi-channel downconverter is in late design. The phase and amplitude calibration schemes are now clear. Simulations are also underway for data analysis tools.

MIT/Lincoln Labs 43m Project

The 43m collaboration between MIT's Lincoln Laboratory, Haystack Observatory, and NRAO entered the initial operations phase in Q4 2005. We began regular measurements of the properties of the Earth's ionosphere using the technique of bi-static radar observations of spacecraft. In this technique, the spacecraft are illuminated by the Millstone Radar in Massachusetts and the reflected signals are collected by the NRAO 43m telescope in Green Bank and also at Millstone. The wideband data are recorded and sent to Lincoln Laboratory for analysis.

We have completed the initial version of the automatic sequencing software and tested the interfaces. The 43m continues to operate well.

Very Large Array and Very Long Baseline Array

Very Large Array (VLA) Highlights

Eight proposals were received at the October 1 deadline, in response to the special call for extragalactic blank field integrations. After refereeing, an external panel was convened by teleconference and recommended awards of time to four of the eight proposals. The four proposals will receive the bulk of their scientific observing time during the A configuration session from February through May 2006. The accepted proposals cover the COSMOS, GOODS-N, SWIRE, and Spitzer First-Look Survey fields.

Additional VLA survey data has been made available to the community via the National Virtual Observatory portal. The latest surveys to be provided are the Cosmic Lens All Sky Survey (CLASS), with over 10,000 images, as well as several thousand images from the MIT gravitational lens snapshot survey. The VLBA Calibrator Survey also has been made available.

Very Large Baseline Array (VLBA) Highlights

Mark 5 recording systems now have been installed at all ten VLBA antennas, and the first 10-antenna Mark 5 observations have been carried out on the VLBA. Following another small procurement of disk modules, we expect to be ready to move to full-time Mark 5 operations at the VLBA by the end of the first quarter 2005.

The AIPS software used for VLBA and VLA data analysis underwent its annual freeze in late December. The frozen 31DEC05 version of this software is now available to the community, and a new 31DEC06 version, updated as often as daily, is being made available by our regular "midnight job." In 2005, nearly 1500 independent IP addresses worldwide were used to download one of the AIPS versions.

Management and Scientific Milestones

Milestones	Original Date	Revised Date	Date Completed
VLA/VLBA Proposal Deadline	10/03/05		10/03/05
VLA Public Tours	10/08/05		10/08/05
Global mm VLBI Session	10/18/05		10/18/05
Second Round of VLA Dynamic Scheduling Tests	10/31/05		10/31/05

Very Large Array and Very Long Baseline Array

Milestones	Original Date	Revised Date	Date Completed
Global cm VLBI Session	11/10/05		11/10/05
AIPS++ Stable Release 15	11/15/05		12/15/05
AIPS 31DEC05 Frozen; 31DEC06 Released	12/31/05		12/29/05
Seven VLBA Stations Full Time on Mark 5 Recording	12/31/05		12/31/05
Full Proposal Tool Release for VLA	09/01/05	01/05/06	
AIPS++ Stable Release 16	01/15/06		
Decision on Outfitting VLA with 190 MHz Systems	08/05/05	02/01/06	
VLA/VLBA Proposal Deadline	02/01/06		
Global cm VLBI Session	03/09/06		
AIPS++ Stable Release 17	03/15/06		
Host International SKA Steering Committee Meeting	03/17/06		
Completion of VLA Archive Imaging Pilot Project	01/31/06	03/31/06	
VLBA Conversion to Full-Time Mark 5 Operations	03/31/06		
AIPS++ Stable Release 18	05/15/06		
VLA/VLBA Proposal Deadline	06/01/06		
Aperture Synthesis Imaging Summer School	06/20/06		
VLA/VLBA Proposal and Large Proposal Deadline	10/01/06		
Retire VLA Modcomp Computers	03/31/06	12/29/06	
AIPS 31DEC06 Frozen; 31DEC07 Released	12/31/06	12/31/06	

Computer Infrastructure Milestones

Milestones	Original Date	Revised Date	Date Completed
Upgrade AOC frame relay to 43Mbit	10/30/05		10/20/05
Phase 1 of renumbering AOC IP address space	10/31/05		11/15/05
Bring up Antenna 18 EVLA MC network (1)	10/15/05	01/15/06	
Migration to Windows 2K domain(2)	07/31/05	01/31/06	
Phase 2 of renumber AOC IP address space	02/28/06		
Upgrade VLA/PT link to T1	02/28/06		
Upgrade all NRAO/NM Linux machines to Redhat Enterprise 4 (3)	12/31/05	03/31/06	

1) Waiting on antenna to be powered up.
2) In progress, approximately 97% done.
3) In progress, approximately 60% done, stalled for AIPS and ALMA issues

Operations Software Support Milestones

Milestones	Original Date	Revised Date	Date Completed
Transcribe VLA observe/system files	11/30/02	01/01/06	
Correlator controller operations by Modcomps	04/04/05	02/28/06	
Correlator controller operational by EVLA Monitor and Control	04/04/05	03/31/06	
Modify JObserve for 2006 leap second	03/31/06		
Translate and copy stored VLA monitor data form 9-track to DAT	03/01/04	06/30/06	

Electronics Milestones

Milestones	Original Date	Revised Date	Date Completed
Projects			
Install two 190 MHz Version 2 receivers on VLA antennas	10/15/05		10/15/05
Upgrade VLBA FRM System, Concept Test at PTVLBA	11/15/05		11/15/05
Upgrade VLBA FRM System, Focus motor replacement installed at PTVLBA and evaluation complete	01/31/06		
Test replacement fuses at PTVLBA	01/31/06		
Receivers (FE)			
Replace the S-Band 13cm Receiver at LAVLBA	10/26/05		10/26/05
Replace the S-Band 13cm Receiver at FDVLBA	10/26/05		10/26/05
Replace the P-Band 90cm Receiver at BRVLBA	10/31/05		10/31/05
Replace the K-Band Receiver at VLA-17	01/11/06		
Replace the X-Band Receiver at VLA-14	01/11/06		
Replace the L-Band Receiver at NLVLBA	01/18/06		
Improvements			
Upgrade the TAC and Servo Boards at MK	07/30/06		
VLBA			
Install new cable wrap at PTVLBA	10/31/05		10/31/05
Install two additional Mark-V Drives	11/23/05		11/23/05
Place 20 additional disk packs into service	11/23/05		11/23/05
Install a Mark-V unit at all ten VLBA sites	01/18/06		12/06/05
Evaluate the Contempo Dehumidification concept at BRVLBA and LAVLBA	12/30/05		12/30/05
Install Single motor FRM rotation system at BRVLBA	01/18/06		
Install ten Mark-V playback units in Socorro Operations	01/18/06		

Milestones	Original Date	Revised Date	Date Completed
Remove the tape recorders at BRVLBA	01/18/06		
Scheduled Maintenance Visit SCVLBA	04/30/06		
Scheduled Maintenance Visit KPVLBA (ACU Upgrade)	06/30/06		
Scheduled Maintenance Visit MKVLBA (ACU Upgrade)	07/30/06		
Scheduled Maintenance Visit HNVLBA (ACU Upgrade)	09/30/06		

Engineering Services Milestones

Milestones	Original Date	Revised Date	Date Completed
Antenna Group			
Complete DnC array reconfiguration	10/14/05		10/06/05
Complete D array reconfiguration	11/04/05		11/01/05
Complete Antenna 20 Overhaul (non EVLA)	12/15/05		12/15/05
Complete Antenna 12 Overhaul (non EVLA)	11/16/05	10/20/05	12/20/05
Remove and Inspect 6 transporter axles	12/22/05		12/22/05
Complete A array reconfiguration	02/03/06		
St Croix VLBA antenna structural inspection	02/15/06		
Remove and inspect 6 different transporter axles	03/30/06		
Complete BnA array reconfiguration	05/26/06		
Complete Antenna 26 Bearing Change (non EVLA)	08/24/06		
Electrical Group			
C and D array transformer PMs	11/30/05	03/31/06	
Adapt VLBA digital tachs to VLA	03/31/06		
Update VLA Electrical Distribution Drawings	03/31/06		
Site & Wye Group			
Jackson Tamper Repair	08/30/05	11/30/05	11/30/05
Surplus Vehicle (three trucks) initial checkout/repair	08/30/05	11/30/05	11/30/05*
D7 Cat Dozer	10/31/05	11/15/05	11/30/05
Complete track repairs between BN6-AN5	12/31/02	11/30/05	11/30/05
1984 MC9 Coach Engine Rebuild	02/15/06		
LWDA site preparation	03/03/06		
Complete firehouse building	03/30/06		
Refurbish 2 railroad ballast cars	04/30/06		
Replace Control Building stairs	06/30/06		
Rebuild two track intersections with concrete timbers	08/30/06		
Line and level track between AN5-AN6	08/30/06		

* Two vehicles complete, third vehicle may not be cost efficient to repair.

Very Large Array and Very Long Baseline Array

AIPS

Key Developments

1. In 2005, a total of 246 sites have downloaded the frozen version 31DEC04, 832 sites have downloaded the development version 31DEC05, and 982 sites have used the AIPS cvs code management facility. In all, 1460 different sites (different IP addresses) appear in one or more of these lists.
2. The 31DEC05 development version was frozen and a new 31DEC06 development version was made available. Prior to this, the CookBook and all ABOUT, APROPOS, and other general documentation files were brought up to date.
3. In this quarter, a procedure was developed which will fetch from the USNO over the web the latest Earth Orientation Parameter (EOP) estimates and apply them to the user's data. A similar procedure for total electron content corrections was also developed.
4. A significant error was discovered when attempting to use sub-images for self-calibration. All calibrator models provided with AIPS were immediately corrected to avoid this error. Later, a fix was made to the software to eliminate this error in the future. The 21-cm (L-Band) model for the fundamental gain calibrator 3C286 was also released during the quarter.
5. A new convenience verb QINP was released to allow resuming an INPUTS display at the current page rather than starting over. A new task CCRES was written to remove and restore Gaussian Clean components from any image. The older RSTOR, which was changed to allow component subtraction as well as addition, requires the components to lie exactly on the image's pixels. The task that captures a TV image to a PostScript output was generalized to read more than one image from disk; this allows large three-color and hue-intensity images to be displayed.

Goals for the First Quarter 2006

1. Continue user support and bug fixes as the major portion of AIPS effort.
2. Add to the task which computes the fluxes of the primary flux calibration sources new (2004 and 2005) flux values and interpolation in time between the tabulated values.
3. Provide support for pipeline data reduction, especially new automatic editing algorithms.
4. Begin investigations of new/improved imaging algorithms, including those dealing with spectral index and multiple pointings.
5. Install modern world coordinate handling software to enhance and replace the original AIPS coordinate handling.

AIPS++

The key activities for this cycle were the system work in support of the framework migration, development for the SS15 and SS16 releases, the ALMA R3 release, and internal testing/documentation for the upcoming ALMA (single baseline commissioning) and EVLA (antenna pointing calibration).

- SS15 *http://projectoffice.aips2.nrao.edu/ss15.html.*

- *SS16 http://projectoffice.aips2.nrao.edu/ss15.html.*

Highlights:

- System/Framework
  - Core synthesis tools ported (calibrator, imager, tableplot, ms and msplot tools).
  - Initial imager tasks provided.
  - Use of IPython for interface.
  - Testing of matplotlib as alternate to pgplotter.
  - Demos given to internal scientists: *http://casa.nrao.edu/gettingstarted.shtml.*
- ADASS presentations, papers (ALMA Data Capture, CASA Framework migration).
- Extended calibration facilities for baseline-based gain, bandpass, and phase, delay and delay-rate solutions).
- Msplot utility for plotting of data versus derived quantities (e.g., hour angle, parallactic angle, etc).
- Support for time, frequency averaging of data sets (ms tool).
- Initial ALMA filler (meta + binary data).
- Refinement of EVLA testing schedule and priorities.
- Revision to ALMA R3.1 release planning based on priority changes; participation in optical pointing team effort:
  - ASDM retrieval, submission and query utility.
  - Simulated OP dataset.
- Improved ASDM programmer documentation; ASDM table browser application; agreement on correlator header content – revised correlator interface document.
- Successful integration between ACS/AIPS++ under RH9 for filler and protopipe.

Goals for the First Quarter 2006:

1. Deployment of CASA for ALMA2006.01-4 test.
2. Port of software to RHE; re-integration with ACS under this OS for R3.1.
3. ALMA Data Capture support for ALMA Telescope Data Model.
4. ASDM/ASDM filler updates.
5. Migration of tables, autoflag to CASA.
6. Incorporation of ASAP (single dish analysis) into CASA.
7. Continued EVLA imaging development (antenna pointing corrections, full beam polar).
8. ALMA Offline release for R3.1.
9. Support for Optical Pointing use case (ASDM, Data Capture).
10. Framework effort on the task/parameter system.

Archive

The NRAO Data Archive has now been operational for more than two years. To date, over 700 users from 250 institutions have downloaded nearly 5 Tbytes of telescope data (40,000 data files). The download data rate has climbed to about 200 Gbytes per month (1600 data files per month). Data files

over one year old are in the public domain and accounted for over one-half of the download volume. The data files reside on a hard disk array and provide the archive users with fast access and downloads via FTP and HTTP.

Currently the archive contains all VLA data going back to 1976, raw VLBA data going back to August 1999, and some calibrated VLBA data going back to September 1993. Efforts to expand the VLBA archive back to 1992 are underway. GBT data from July 2002 through October 2004 are available, and GBT data are about to be transported to the AOC to bring the archive up-to-date.

During the third and fourth quarters of 2005, we registered 9 services with the National Virtual Observatory. The services are six image atlases and three radio source catalogs. There are now over 55,000 images from the NVSS, FIRST, VLBA 2cm, CLASS, MITVLA and the VLBA Calibrator Survey (VCS) surveys registered and available to Virtual Observatory users. The three radio source catalogs contain positions and flux densities of radio sources identified in the NVSS, FIRST and WENSS radio surveys. During the first quarter 2006 we expect to expand the VCS survey image collection with new images provided by the GSFC VLBI Group.

Proposal Tool

After the successful second round of GBT proposals in early October 2005, work in the fourth quarter concentrated on a general code re-factoring, and adding support for submitting VLA proposals.

The code re-factoring was needed following the departure of the chief proposal tool programmer, and to bring the architecture more in line with the framework agreed upon in the meantime for other Web applications such as observation preparation, archive access, etc. This re-factored code will not be officially released until May 2006.

In October 2005 a group of AOC astronomers tested the VLA part of the proposal tool. Their feedback was incorporated in a new release tested internally in December 2005. If given the green light, this version will be used for the February 2006 proposal deadline. This will mark the last time the old code framework will be used.

Virtual Observatory

NRAO is a partner in both the U.S. National Virtual Observatory (NVO) and the International Virtual Observatory Alliance (IVOA). The NRAO is active in VO development on three fronts: (1) participation in development of the international VO framework (e.g., IVOA data access and FITS standards development); (2) providing radio data and services to the VO; and (3) coordination of NRAO software development with the VO architecture and technical infrastructure.

Further progress has been made on the effort, begun earlier this year, to integrate existing radio image data collections into the NRAO archive. We now have data online for NVSS, FIRST, the VLBA 2 cm survey (2 cmVLBA), the VLBA calibrator source survey (VCS), the cosmic lens all-sky survey

(CLASS), and the MIT gravitational lens snapshot survey (MITVLA). Consistent image metadata and data access services, using the VO simple image access protocol, are provided to a total of about 55000 images. We are still in the process of testing and tweaking the services. Acquisition of additional data collections will continue.

Work continues on the archive imaging pilot project, an effort to develop an automated pipeline for processing archival VLA B-configuration data. Development of the pipeline processing heuristics is still in progress, and we have not yet begun bulk processing to produce image data.

At present it does not appear that resources will be available to proceed with the full NRAO VO plan as outlined earlier this year. Discussions are currently underway to identify a subset of the work which can be done with current resources, possibly augmented by temporary hires. This effort includes further work on the archive infrastructure, as well as ongoing acquisition of radio data collections and making the data available via standard VO services. As part of this effort we plan to gradually replace the current SAN-based disk storage with PC-based intelligent storage modules running the NGAS software used by ALMA and ESO.

A workshop on the VO data access layer was held in October at the IVOA fall interoperability meeting hosted by ESAC outside Madrid. The main focus of activity continues to be the simple spectral access interface, and in particular on development of standard data models and related data model technology for uniformly characterizing and representing astronomical data and accessing such data from analysis programs. Work is also underway on automated service verification, non-invasive logging of services, single sign-on authentication to provide secure access to proprietary data, and asynchronous staging of data. A draft specification for a new spectral line access protocol, with an associated spectral line data model, was presented in the fall interop along with demonstration applications using the new protocol. Planning for an upgrade to the simple image access protocol is in progress.

An initial analysis of what is required to access radio spectral data cubes within the VO has been performed. This was prompted by a query from Arecibo, which is beginning a major HI survey which will produce a large amount of spectral image cube data using their new focal plane array (similar data is already available from the Canadian and Southern (Parkes) galactic plane surveys and others). In general this data is too voluminous to be practical to download and analyse locally in the conventional fashion. The current plan is to extend the VO image access interface to support cube data, and produce services which can dynamically produce 2D or 3D image cutouts (subsections) or reprojections from the archival data. The spectral access interface can also be used to dynamically extract 1D spectra from the cube at any XY location, using a synthetic aperture. Another approach is to produce a fully distributed analysis application, with the user interface running locally on the user workstation but with most access-related computation taking place on the remote server where the data is located.

Distributed analysis in the manner outlined above can already be performed in an adhoc fashion, but one goal of VO is to develop standard infrastructure to support this type of application. Support for distributed analysis of this type is one goal of the component framework we are researching as a collaboration between NRAO, NVO, and the OPTICON network in Europe. A two-day workshop on this

topic was held in connection with the ADASS conference in October. Participation on the U.S. side included representatives from NRAO and ALMA as well as STScI. A very well-attended birds-of-a-feather session was also held during the ADASS to review the component-framework architecture developed over the past year with the broader community, as well as hear about related efforts elsewhere within astronomy. Recent work has focused on evaluation of specific technology (in particular the Ice and D-Bus message bus frameworks) being considered for the second year of the effort, which will focus on prototyping core elements of the architecture such as the container and parameter mechanism.

Central Development Laboratory

Central Development Laboratory Highlights

Redesign of the 35-46 GHz amplifier to achieve flat noise and gain over the 40-50 GHz frequency range was successfully completed, and a prototype tested. Similar redesigns have begun for the K and Ka-Bands.

A 4-12 GHz superconducting 180-degree IF hybrid has been designed for balanced mixer work. It is currently being fabricated at the University of Virginia Microfabrication Laboratory.

Measurement of a new set of Ka-Band phase shifters and a detailed analysis of the GBT beam at 1.4 GHz were completed.

The correlator configuration was converted from the hybrid 2-antenna /64-antenna configuration to the full 64-antenna configuration. Software has been tested to adjust the full 64-antenna station to correlator interface. Construction of the second quadrant continues.

The final two X6 frequency multipliers for ALMA Band 9 were cryogenically evaluated and made available to the Band 9 cartridge group for use in the next cartridge assembly.

Active multiplier chain and power amplifier blocks for bands other than Band 9 are being assembled and tested to supply the first 8 ALMA receivers. Accelerated life testing is ongoing for the InP MMIC power amplifiers. InP PAs will be replaced with GaAs-MMIC PAs in the Band 6 WCAs.

ALMA Band 6 cartridges 1 and 2 were successfully tested in Cryostat #1.

Orders were placed for the ALMA Front End tilt table, cartridge loader, and environmental chamber. The Front End test electronics were received and custom modules tested.

A set of antennas is being designed to replace the 20-70 MHz dipole currently in use for the GB/SRBS. Solar activity continues to be monitored over the 20-70 MHz and 250-1000 MHz bands by GB/SRBS Phase II.

Central Development Laboratory

Major Developments

Milestone	Original Date	Revised Date	Date Completed
Amplifier Design & Development:			
Evaluation of TRW Cryo-3 devices from the point of noise, signal and dc properties at cryogenic temperatures	04-01-04	ongoing	
Design/redesign of cryogenic amplifiers using Cryo-3 TRW devices for EVLA, VLBA, GBT and ALMA covering frequency range from 1 to 120 GHz	04-01-04	8-31-06	
Electromagnetic Support:			
Design of EVLA Ku-Band feed	09-30-04	06-30-06	
Develop dual frequency 300/600 MHz feed for the GBT	09-30-05	03-31-06	
Design of ALMA holography feeds	03-31-06		
Measure EVLA S-Band prototype feed	06-30-06		
ALMA Correlator:			
Support system testing at the AOC as far as the correlator is concerned	03-31-04	ongoing	
Continue to receive and test production circuit cards	09-30-04	ongoing	
Finish motherboard PCB layout of a modified SCC test fixture	12-31-04	11-30-05	11-07-05
Complete test cable timing training software effort	12-30-05		12-30-05
Complete at least 1/4 of initial rack construction of the second quadrant	12-30-05	03-01-06	
Complete testing of the prototype TFB card in the system	12-30-05	ongoing	
GB/SRBS Phase II:			
70-300 MHz, dual polarization, log-periodic on 45-foot telescope, new analog spectrometer	03-31-05	03-31-06	
GB/SRBS Phase III:			
10-80 MHz, dual polarization, four crossed dipoles, new digital spectrometer	09-30-05	06-30-06	
80-300 MHz, dual polarization, log-periodic on 45-foot telescope, new digital spectrometer	09-30-05	06-30-06	
300-2500 MHz, dual polarization, 45-foot telescope with log-periodic feed, new digital spectrometer	09-30-05	09-30-06	

Amplifier Design and Development

The effort to redesign the 35-46 GHz amplifier to achieve flat noise and gain over the 40-50 GHz frequency range has been successfully completed, and a prototype has been tested. Similar efforts to improve gain flatness in the K- and Ka-Band designs have commenced.

Central Development Laboratory

Amplifier Production

Fourth-quarter production totaled 27 new and upgraded amplifiers. This included three low noise L-Band, three high dynamic range L-Band, eight S-Band, and two Q-Band amplifiers as new production for use by the EVLA. The remainder of the quarter's production was primarily Cryo-3 upgrades of existing amplifiers and several repairs.

Other Projects

The Chemistry Laboratory continued to meet all immediate plating needs, but did experience a shutdown for several weeks to allow for replacement of one of the gold baths and maintenance of the entire gold-plating system.

Superconducting Millimeter-Wave Mixer Development

ALMA Receiver Work

Band 6 sideband-separating mixer-preamps: Work continued on mixer production and evaluation of mixer chips from different wafers. Good mixers have been obtained from all nine wafers, but it remains to be determined which of the four different tuning configurations on each wafer gives the best results.

Band 6 mixer test system: This system is now making unattended measurements using an automatic filling system to maintain the liquid nitrogen level in the cold load. A full set of measurements takes ~23 hours.

Band 6 4-12 GHz preamplifier production: ACC struggled during this quarter to build an additional 24 cold IF preamps. They again paid for our technician Michael Lambeth to visit the factory and teach them (again) how to assemble preamps. It appears we had inadvertently sent them defective HFETs from the Cryo-3 set obtained last quarter from JPL, but the defect is evident only when cold. To accelerate assembly and rework when devices prove defective, we are now considering allowing ACC to install all components except the HFETs.

Band 6 cartridges: Serious manufacturing and design flaws were found in our original order of dual 51-pin bias connectors. They will be replaced with better connectors from another vendor.

To remedy a shortage of LO power at a few points at the lower end of the band, the length of the stainless-steel WR-10 input waveguides to the LO triplers was reduced and the overmoded stainless-steel waveguide between the tripler and mixer was copper-plated inside over part of its length. To reduce dips in the transmission of the overmoded waveguide, resistive mode suppressor cards were inserted into the ends of the waveguide. The optimum absorber length and surface resistance were determined

experimentally. The modified LO waveguides were installed in Cartridge 3 which will be the first cartridge to enter production testing.

Eight LO vacuum windows were fabricated, gold-plated, leak tested, and pressure tested. We now have window assemblies ready for Cartridges 3-6, and eight more are awaiting gold-plating and testing.

Cartridge frames 3 and 4 were received from RAL. The 300 K plates for both cartridges were modified and dowel pins installed. Assembly of components for Cartridges 4-8 has begun. The 4 K cable heat sinks, temperature sensors, and heater resistors were completed, and the wires to fabricate the pigtails for the 4 K plate have been stripped and are awaiting final assembly.

A base plate assembly for the Band 7 cartridge was leak tested for IRAM using the same procedure as for Band 6.

Band 6 cartridge test system: We have nearly finished moving the cartridge test system from the NTC ALMA Integration Center, where space is at a premium, to the mixer test lab.

We continue to investigate the cause of the sidelobe reported earlier. The next step will be to replace the HDPE IR filters with Gore-Tex to see if the HDPE filters are the cause of the sidelobe.

The new version of the cartridge bias supply was found to degrade the cartridge's gain stability (although it still met specifications). This appears to result from voltage spikes generated by the bias supply (*http://www.cv.nrao.edu/~jeffland/GainStability2005-11-29.pdf*). The bias supply layout is being revised in Green Bank.

Band 3 and Band 6 OMT development: This quarter, two Band 6 and two Band 3 orthomode transducers (OMTs) have been assembled and are ready for testing. To date, all testing of the Band 3 and Band 6 OMTs has been done at room temperature. A plan has been developed for cryogenic testing in liquid nitrogen, rather than using a dedicated liquid helium cryostat, and the necessary waveguide components are now being fabricated.

Non-ALMA Millimeter-Wave Development

Balanced SIS mixer development: Balanced mixers have two desirable characteristics for radio astronomy receivers: (i) Their sensitivity is not degraded by LO sideband noise, thus improving the most sensitive SIS receivers and permitting the use of noisy LO sources such as photomixers; and (ii) the LO power required by a balanced mixer is typically 50 times less than that required by a conventional single-ended mixer, thus making balanced mixers particularly attractive at very high frequencies (where high LO power is not available) and for focal-plane array receivers in which a single LO must drive many mixers.

Central Development Laboratory

A critical component of a balanced mixer is a 180-degree IF hybrid which separates the downconverted signal and LO sideband noise. We have designed a superconducting 180-degree IF hybrid covering 4-12 GHz which is small enough to be mounted inside the mixer block. An additional advantage of this hybrid is that it will enable a balanced SIS mixer to operate from a single bias supply. The hybrid is being fabricated at the University of Virginia Microfabrication Laboratory. This work is being funded in part by the Arizona Radio Observatory of the University of Arizona.

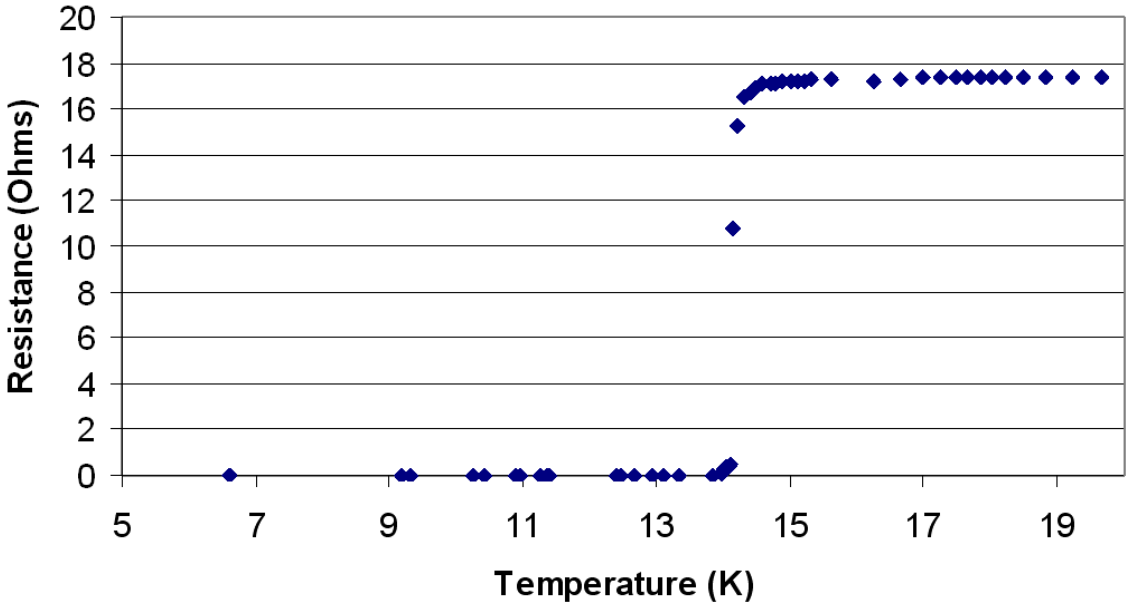


Figure 1. Resistance vs. temperature plot for a NbTiN film [T. Cecil, M.S. Thesis, UVA, 2005].

350-μm receiver technology development: Our collaborator in this work, the University of Virginia Microfabrication Laboratory, has developed a process to produce high quality NbTiN films — a major step towards NbTiN SIS junctions. Figure 1 shows the sharp superconducting transition at ~14 K.

There are two important reasons for undertaking this work: (i) success in this project will put NRAO in a strong position to bid on ALMA Band 10 receiver production; and (ii) this project will provide bridging funds to keep millimeter-wave receiver development alive at NRAO and UVA between the end of the ALMA development phase and the beginning of its operations phase in about three years when there is expected to be funding available to support further receiver development.

Considerable time was spent this quarter seeking funding for the second year of this project, both through direct NSF funding and through a collaboration with a third organization (in addition to NRAO and UVA).

385-500 GHz SIS mixer: This is a joint project between NRAO and the University of Virginia Microfabrication Laboratory and has been supported mainly by UVA through an NSF grant. In this quarter, development of the junction fabrication process at UVML and the design of the mixer block have been suspended due to the lack of funding and manpower. We hope that this project will be able to be continued in the next quarter.

Investigation of Beam Lead HEB Mixers for Heterodyne THz Biohazard Detection

This began as a SGER (Small Grant for Exploratory Research) awarded by the NSF under the ACT (Approaches to Combat Terrorism) program. This was a one-year program to build, measure and compare different types of beam lead HEB mixers in a 600-720 GHz receiver using existing NRAO equipment. We are currently collaborating with Prof. Robert Weikle to measure the IF characteristics of a diffusion-cooled HEB mixer.

The same receiver setup will be used to test NbTiN SIS mixers for ALMA Band 10. NbTiN films with encouraging properties have been successfully fabricated for us by the UVA Microelectronics Laboratory.

Electromagnetic Support

Measurement of a new set of Ka-Band (26-40 GHz) phase shifters was completed. Each one in the group was found to have satisfactory performance.

A detailed analysis of the GBT beam at 1.4 GHz was completed. Calculations of the near and far sidelobes at several cuts in the azimuthal plane were performed.

Spectrometers/Correlators

ALMA Correlator

Construction and testing of the first quadrant of the ALMA correlator are essentially complete. All assembled printed circuit cards for the four quadrants have been received. All correlator cards have been tested. Card testing for the entire correlator is almost complete. Construction of the second quadrant of the correlator has begun.

The correlator cabling was converted from the hybrid 2-antenna /64-antenna configuration that has been used for TFB testing to the full 64-antenna configuration. Software has been tested to automatically adjust clock phases in the full 64-antenna station-to-correlator interface for the first time, verifying that all interfaces work error-free. This capability has been implemented for the integer portion of the interface timing.

The remaining LTA-to-final adder and final adder-to-DPI interface cables have been installed and we have verified valid data transfers and proper summation of results in the complete adder tree when summing 32 planes of identical results.

ALMA Frequency Multipliers

The status of the cooled local oscillator frequency multipliers for the various ALMA frequency bands in the baseline plan is described.

Band-3: No cooled frequency multiplier stage is required for this ALMA band.

Band 6 and Band 7: Frequency multipliers for these bands have been procured and accepted as reported earlier. The cryogenic evaluation of individual units continued in this quarter.

Band 9: As described in earlier reports, two X6 frequency multipliers were assembled and delivered to the Band 9 cartridge group after cryogenic evaluation for the integration into the first cartridge. VDI subsequently assembled and delivered another pair of similar frequency multipliers which were the final deliverables under the current development contract. These units were cryogenically evaluated at NRAO and made available to the Band 9 cartridge group for use in the next cartridge assembly.

Alternative approaches: Several alternatives (including the three varactor frequency doubler cascade based on the JPL Herschel design, relocating the power amplifiers inside the cold cartridge, power-combining existing amplifiers, etc.) were investigated. Subsequently, four approaches were selected based on the criteria of minimum cost and schedule impact on the project. From these, three options were chosen based on the arguments put forth in the previous quarterly report – of which one was simply increasing the drive power by power-combining amplifier chips for the frequency sextupler option. The other options are multiplication factors of X9 and X10. These approaches are being pursued and evaluated.

After the performance of the above two options are evaluated by April 2006 (including evaluation of the harmonic performance that requires FTS testing at SRON/Netherlands), one of the approaches will be selected for pre-production/production.

An investigation into the procurement of frequency multipliers for the Japanese bands 4 and 8 also continued in this quarter.

ALMA LO Source

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

are part of a subassembly called the Warm Cartridge Assembly (WCA) which interfaces to the cartridge on the back of the cryostat.

Based on Accelerated Life Testing of the InP power amplifiers and the fact that we are at the high limit of available power at the low end of the Band 6 frequency range, we have investigated the use of a GaAs MMIC power amplifier (PA) replacement. A Band 6 LO with a GaAs-based AMC and PA block was recently tested with the second Band 6 cold cartridge and showed no measurable difference in terms of sideband noise from the InP PA, but with much more available power than needed by the Band 6 cartridge. In the next quarter, we will upgrade the other Band 6 WCAs to GaAs.

Active multiplier chain (AMC) and power amplifier (PA) blocks for bands other than Band 9 are being assembled and tested in batches to supply the first 8 ALMA receivers.

For Band 9, drivers using GaAs pHEMT MMIC PAs are being investigated. We are expecting deliveries in the next month of new amplifier designs including a 60-72 GHz, 200 mW design to drive a doubler-quintupler for Band 9, as well as designs for Bands 4 and 8. Blocks to test the new chip designs have been fabricated and microassembly begun.

Accelerated life testing is ongoing for the InP MMIC power amplifiers and is yielding valuable information. We will eventually be able to determine lifetime as a function of operating temperature, input power, and drain bias. This is valuable not only to the ALMA bands that will use InP, but also to many outside groups.

LO power amplifiers (all ALMA bands): Delivery of a GaAs wafer run from the NGST foundry is now expected by the end of February (it was temporarily delayed by a problem with e-beam lithography at NGST). This wafer carries new designs for Bands 4, 8, two Band 9 options, and an already proven design for Band 6 that can deliver more power with better reliability than the InP amps that have been used so far.

Several new power amplifier bodies have been fabricated for these chips to allow quick verification of the layouts and deployment in production LO assemblies.

A post-doc from the ASIAA Institute in Taiwan has been at the NTC since April 2005 investigating the possible use of MMIC HBT VCOs for the ALMA LOs. This work has the potential to eliminate much of the expense, volume, and heat-load burden caused by the use of commercial YIG-tuned oscillators. Figure 2 shows a lower-frequency prototype built using a commercial surface-mount Si HBT and varactor. Forty percent tuning bandwidth was measured with good phase noise, as shown in Figure 3. More importantly, measurements agreed well with the models, increasing our confidence in the simulations used for future MMIC design. The next steps are the design and simulation of a suite of MMIC VCOs using WIN Semiconductor's HBT process.

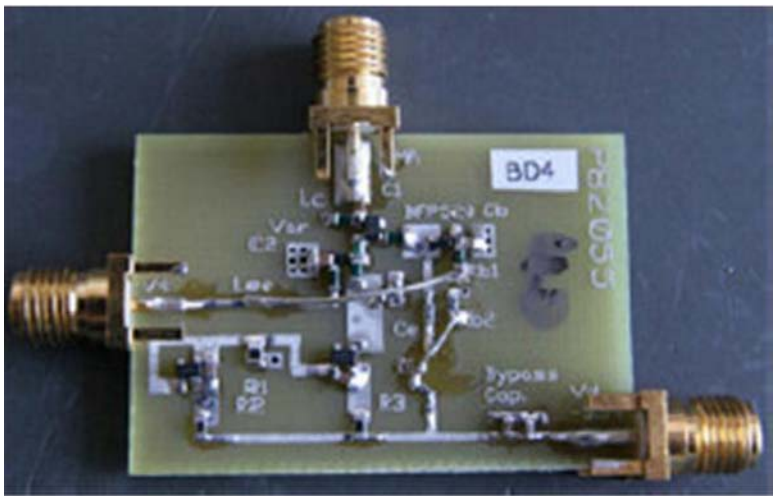


Figure 2. VCO layout on FR4 board with approximately 800 MHz center frequency. and 40% tuning bandwidth. Board size is 1.5″x1.1″.

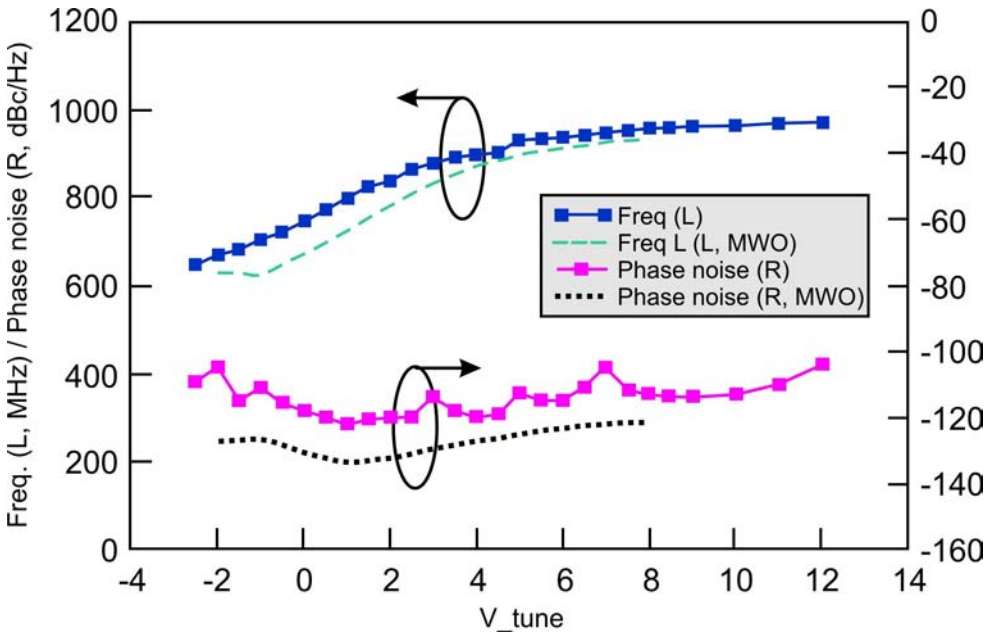


Figure 3. Measured (solid line) and simulated (dashed line) oscillation frequency and phase noise at 1 MHz offset vs. tuning voltage. The arrows indicate which axis each trace is plotted against.

Central Development Laboratory

Green Bank Solar Radio Burst Spectrometer (GB/SRBS)

In June 2003, the NRAO received an NSF MRI grant to develop a high-performance instrument to receive solar radio emissions with adequate temporal and spectral resolution to probe a wide variety of active solar phenomena from the base of the corona, including energy released from flares, particle acceleration, and escape, coronal shocks, and electron beams. The instrument consists of two radio spectrometers that will together provide frequency coverage from 10-2500 MHz. This instrument provides a basic research tool in solar radiophysics for use by the wider community, remedies the lack of an important component of the U. S. Space Weather effort, and provides a platform for research and development work on broadband antennas, feeds, and receivers needed for the upcoming Frequency Agile Solar Radiotelescope (FASR) project. A significant portion of the development work is being performed at the NRAO Technology Center (NTC) in Charlottesville. Solar activity continues to be monitored over the 20-70 MHz and 250-1000 MHz bands by GB/SRBS Phase II.

The 70-300 MHz, dual-polarization, wide-bandwidth antenna is currently being fabricated in Green Bank to complete Phase II. Fabrication has been delayed due to personnel shortage in the machine shop. Deployment is now scheduled for March 2006.

Development of the 300-2500 MHz downconverter continues.

A set of antennas is being designed to replace the 20-70 MHz dipole currently in use. The new design will extend the lower frequency limit down to 10 MHz (to overlap with the spectral range of the WIND/WAVES spacecraft) and the upper limit to 120 MHz. A fat dipole will be used from 10-30 MHz, but scaled versions of sleeved-dipole designs, which provide a wide field-of-view and good impedance matching over a 40% bandwidth, will be used to 120 MHz. Deployment is scheduled for summer 2006.

An improved 300-3000 MHz feed/LNA package is being designed for GB/SRBS. The feed will also serve as a prototype for FASR. Two designs are being considered: (1) planar sinuous antenna over an absorber; and (2) inverted conical sinuous antenna over a ground plane. Both antennas have been simulated using CST Microwave Studio. Feed point impedance versus frequency has been measured on a rudimentary planar version located inside our anechoic chamber. Results show excellent impedance control. A prototype of the conical version is currently under construction. An active balun that was designed specifically for these antennas is now being fabricated. These tasks are being performed by a graduate student as part of the NRAO-University of Virginia Instrumentation Program.

Detailed planning is under way for the Phase III upgrade which is scheduled for completion by September 2006.

Education and Public Outreach

Education and Public Outreach (EPO) Highlights

A 2006 NRAO Calendar was produced, and the 2006 NRAO/AUI Image Contest was announced. The three NRAO exhibits were re-designed and re-built. New ALMA, EVLA, and GBT brochures were produced. Production began on a new Observatory-wide brochure targeting the general public. The Observatory issued three well-received press releases. EPO education personnel collaborated with the Society of Amateur Radio Astronomers on a $40K NASA *Ideas* Grant to fund a new NRAO outreach program called *Navigators*. EPO submitted a $7.2M proposal to the New Mexico State Legislature for the design and construction of a new Visitor and Education Center at the Very Large Array. The CY 2005 VLA Visitors Center attendance was 21,832 persons; the CY 2005 attendance at the Green Bank Science Center was 44,717 persons. More than 700 persons attended a very successful Community Open House held in Charlottesville on October 23.

Legacy Imagery Project

A full-color 2006 NRAO Calendar was produced using the nine visually compelling images awarded prizes in the 2005 NRAO/AUI Image Contest and three excellent images selected from the NRAO Image Gallery. This 2006 Calendar was distributed with each copy of the January 2006 NRAO Newsletter, and it will also be distributed widely at the up-coming American Astronomical Society (AAS) meeting being in Washington, D.C.

The 2006 NRAO/AUI Image Contest was announced via a new flyer. The contest website, which includes a user-friendly fill-in-the-blanks submission tool, has been renovated and enhanced with links to the winning images of the 2005 NRAO / AUI Image Contest. The submission deadline for the 2006 NRAO/AUI Image Contest is September 1, 2006.

Astronomical Community

Three NRAO exhibits (NRAO Operations, ALMA, EVLA) were re-designed and re-built this quarter, resulting in a complete renovation of the Observatory's traveling exhibits that represent its science, operations, and construction projects at the AAS and other professional astronomical community meetings. In addition, new ALMA, EVLA, and GBT brochures were produced by EPO, scientific, and project staff in Charlottesville, Green Bank, and Socorro. These brochures will be widely distributed at the Washington D.C. AAS meeting, including the ALMA and EVLA Town Meetings, at the Observatory's AAS exhibits, and at the mid-January North American ALMA Science Center z-*Machines* workshop being held in Charlottesville.

Education and Public Outreach

Publications

EPO personnel initiated work this quarter on a new Observatory-wide, high-quality color brochure whose target audience is the general public. A second, longer and more complex Observatory-wide brochure will target the professional astronomical community and will be collaboratively written by EPO and scientific staff. This brochure will strive to attract new users to radio astronomy and the NRAO. Both of these new brochures will be available by August 1, 2006.

News / Media

The Observatory issued three press releases this quarter. An October 12 release described a major award presented by the International Academy of Astronautics to the team responsible for the VLBI Space Observatory Program (VSOP), including NRAO staff members Ed Fomalont and Jon Romney. New research conducted at the Very Long Baseline Array (VLBA) on the super-massive black hole at the Galaxy's core was the subject of a joint NRAO – Harvard Smithsonian Center for Astrophysics press release on November 2 that attracted considerable media attention, including a long New York Times article and television news coverage in major markets. A December 19 press release described recent Green Bank Telescope (GBT) observations that place stringent limits on the possible variation of two fundamental constants.

EPO effort was also invested in the planning and logistics for a press conference and press reception being hosted by NRAO / AUI at the AAS meeting in Washington D.C.

Education

Green Bank and Socorro EPO education personnel collaborated with the Society of Amateur Radio Astronomers to write and submit a NASA *Ideas* Grant that, if awarded, would be administered by the Space Telescope Science Institute. The proposal requested ~ $40,000 for a two-year program to train 20 volunteers as NRAO *Navigators*, bringing radio astronomy to public venues beyond the reach of our science centers and programs. Each of these 20 volunteers will seek to reach 100 people in their first year as a *Navigator* and will train other volunteers in subsequent years. The next round of NASA *Ideas* grants will be awarded in March 2006.

Green Bank scientific and technical staff organized and hosted a nine-week elective course for local 8th graders. The course, called *Gadgets and Gizmos of Modern Science,* introduced 16 students to computer science, engineering, and scientific careers through a hands-on curriculum. Students participated in the course twice a week for nine-weeks at the Observatory Science Center. Students and staff demonstrated aspects of the course to the Pocahontas County Board of Education in December.

Education and Public Outreach

Visitor Centers

Owing to the availability of unexpectedly large oil and gas tax revenues, the state of New Mexico plans to fund a number of Capital Outlay projects in 2006. Thus, the NRAO has submitted a $7.2M proposal to the New Mexico State Legislature for the design and construction of a new Visitor and Education Center at the Very Large Array. This proposal was submitted through, and is supported by, the Socorro area's representative in the state House, Representative Donald Tripp, and the area's state Senator, Benjamin Altamirano. Since the state's anti-donation clause precludes either AUI or NSF from acting as a fiscal agent for a bricks-and-mortar project such as we have proposed, we have solicited a collaboration with the University of New Mexico (UNM) and the University has agreed to act as fiscal agent, if this project is funded. UNM would also collaborate in the center's design, construction, and management. Since 2006 is a "short-session" year for the New Mexico Legislature, the state House and Senate will convene for only 30 days, beginning in mid-January 2006. A final decision regarding the NRAO Capital Outlay proposal is expected by February 28, 2006.

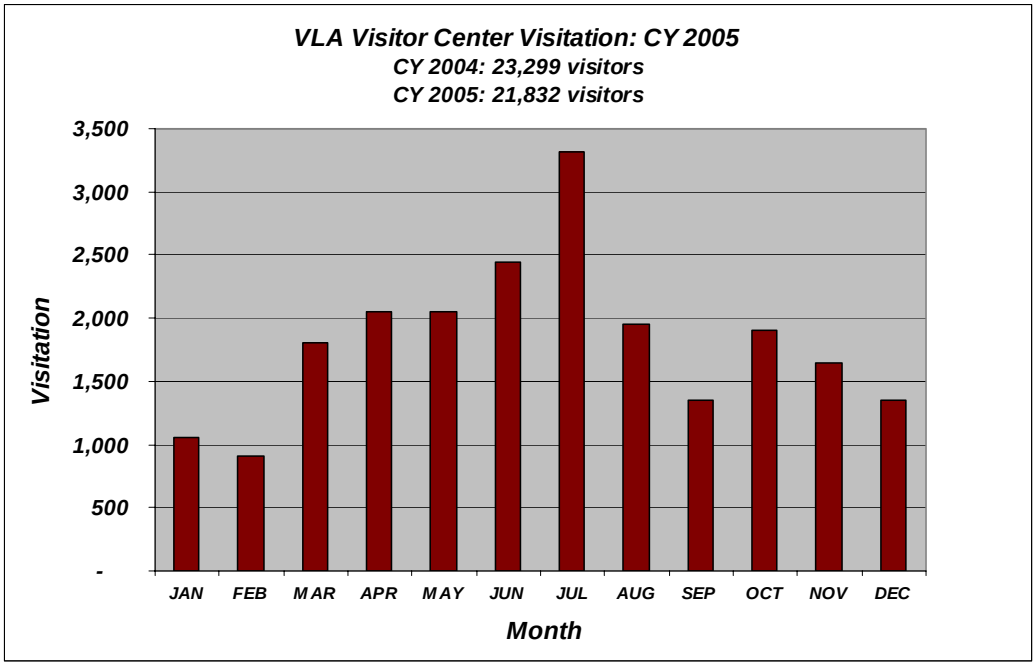
On the first day of this quarter, October 1, the VLA held its semi-annual guided tours for the general public, and EPO personnel hosted more than 271 visitors on this day alone. Table 1 lists the visitation figures for the Green Bank Science Center and the VLA Visitors Center for the quarter: October through December 2005. Compared to the same period in 2004, visitation at the VLA Visitor Center increased by 7.2% (330 persons), and visitation at the Green Bank Science Center increased by 1.9% (152 persons).

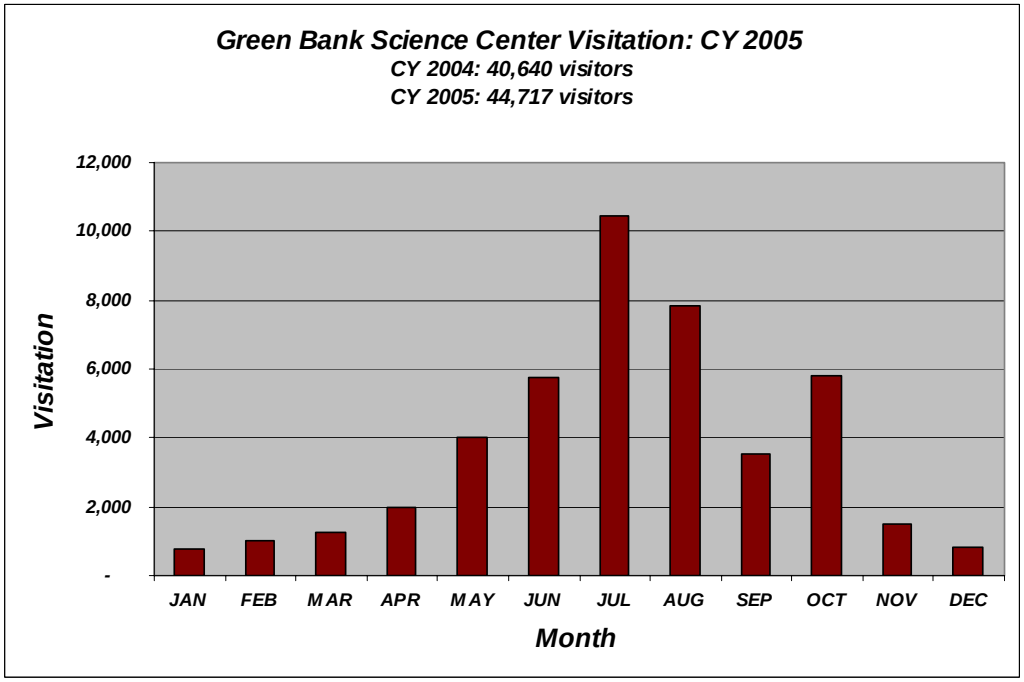
Table 1. Green Bank Science Center and VLA Visitor Center visitation.

Site	Oct 05	Nov 05	Dec 05	Total
Green Bank	5,783	1,514	819	8,116
VLA	1,906	1,643	1,346	4,895

Figures 1 and 2 illustrate, respectively, the CY 2005 visitation at the VLA Visitors Center and the Green Bank Science Center. The CY 2005 attendance at the VLA Visitors Center was 21,832 persons, a decrease of 6.3% (1,467 persons) from CY 2004. The CY 2005 attendance at the Green Bank Science Center was 44,717 persons, an increase of 10.0% (4,077 persons) compared to CY 2004.

Education and Public Outreach





Education and Public Outreach

Community Relations

The first NRAO Charlottesville Community Open House was held Sunday, October 23, 2005 from 11 a.m. to 4 p.m. Approximately 715 guests (500 adults, 215 young people) visited the Observatory to enjoy the numerous Open House programs, exhibits, educational games, and talks about NRAO science and technology. This Open House was made possible by the generous donation of time and effort by the Observatory's staff and their families, members of the Charlottesville Astronomical Society, and colleagues from the University of Virginia Astronomy Department.

Administration

Fiscal Division

During this past quarter, the Fiscal Division was involved in system changes as follows: a revised chart of accounts, general ledger enhancements, upgrade of accounts receivable procedures, initiation of new accounts payable procedures, and continued work on payroll conversion which went into operation on January 1, 2006. This was accomplished while having the fiscal year end close on September 30, 2005. Also, during this period the annual audit by KPMG took place and NRAO continued to receive complimentary results.

Business Services

The table below represents NRAO Operations (without EVLA) expenses and commitments for the First Quarter 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 operations carryover that is committed, $902,208 in prior year operations carryover and $4,011,535 in Green Bank Track repair carryover. To date, $11,850,000 in new NSF funds for NRAO Operations has been received.

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

Work Breakdown Structure Element Level 1	Salaries & Benefits	Materials & Services	Travel	Revenue or Cost Recovery	Total
Observatory Management	$830,874	$1,177,892	$55,382	($51,781)	$2,012,367
Education and Public Outreach	$110,096	$50,202	$1,998	($34,247)	$128,049
Central Development Lab	$246,835	$173,174	$5,454	-	$425,463
Green Bank Operations	$1,789,852	$846,639	$14,053	($125,586)	$2,524,958
New Mexico Operations	$2,847,678	$1,020,821	$34,358	($28,196)	$3,874,662
ALMA Operations	$181,628	$35,619	$3,032	($1,165)	$219,114
Computer and Information Services	$198,584	$161,948	$1,893	-	$362,425
Division of Science and Academic Affairs	$913,452	$204,352	$36,229	-	$1,154,033
	$7,118,999	$3,670,648	$152,399	($240,976)	$10,701,070

Administration

Environment, Safety, and Security

This quarter, in New Mexico, ES&S initiated the electrical arc flash safety program and completed the annual air emissions summary for the site. At Green Bank, the fire system links between all major site buildings were installed and are properly functioning. In Charlottesville, the NTC was inspected for potential fire and security improvements. Lastly, at all major sites, the field work for the planned environmental audit was completed. A final environmental status report is pending at this time.

NRAO-New Mexico

During this quarter ES&S conducted safety training for contractors, employees and visitors. There were 10 different employee safety training sessions conducted and information provided to official visitors on the safety topics of Lock Out/Tagout and Fall Protection. Additionally, two site individuals became certified to provide training in Cardio Pulmonary Resuscitation (CPR) and in the use of Automated External Defibrillators (AEDs).

This quarter marked the initiation of the arc flash electrical safety program. This program is still in development and will be designed to protect workers from accidental arcs when working on or near live electrical circuits.

This quarter ES&S continued to record monthly emission for the EPA New Mexico Air Quality Bureau. The 2005 annual summary emission calculations were completed and submitted for the New Mexico EPA Air Quality Bureau Emission Inventory. This includes a summary of the biannual generator operating information for the stand-by generators.

NRAO-Green Bank

This quarter, ES&S provided oversight of the installation of the fire alarm link to the outlying buildings at Green Bank. This provides essential fire system supervisory capabilities for all essential structures at Green Bank from the control room in the Jansky Lab. Repairs were also completed to the Jansky Lab sprinkler system.

Site-wide inspections this quarter included a review and update of the insurance information in site vehicles. The site cafeteria was inspected for compliance with the West Virginia State Food Code. Additionally, all site first aid supplies were inspected to ensure sufficient supplies are present and in appropriate condition.

Various training sessions were provided including refresher Hazard Communication training, and periodic training for the Rope Rescue Team including hoisting and lowering personnel from the deck and discussion of possible rescue scenarios associated with telescope access. Lastly a safety meeting was held to provide safety information on cold stress and included information on frostbite, hypothermia, and what to do to prevent cold stress injuries.

Administration

NRAO-Charlottesville

This quarter, several potential safety and security concerns at the NTC were identified. The facilities have been examined for fire and life safety as well as potential security access control concerns. ES&S is taking the lead in identifying the requirements for the possible solutions to the issues.

Future Efforts

Next quarter, the results of the environmental audit will become available and ES&S efforts will be provided to address any identified deficiencies. Additionally, the scope of issues identified at the NTC facility will be addressed and a remediation plan forwarded.

Telescope Usage

The NRAO telescopes were scheduled for research and maintenance during the fourth quarter of 2005 as described in the table below. Note that time lost and actual observing for the arrays are computed as fractions of the total antenna arrays. For example, losing 27 VLA antennas for one hour counts as 1.0 hour of time lost, while losing one out of ten VLBA antennas for one hour counts as 0.1 hours of time lost. Also note that in the case of the GBT, Test and Calibrations occasionally require less time than is scheduled for them, and the excess time is then allocated to refereed backup science programs.

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

Telescope Usage			
Activity	**VLA** (hrs)	**VLBA** (hrs)	**GBT** (hrs)
Scheduled Observing	1530.0	1219.0	1561.0
Scheduled Maintenance and Equipment Changes	186.0	99.3	157.0
Scheduled Tests and Calibration	424.5	211.0	418.0
Time Lost	318.63	97.8	110.0
Actual Observing	1211.37	1121.2	1451.0

GBT Observing Programs

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

No.	Observer(s)	Programs
BB184	Braatz, J. A. Greenhill, L. J. (CfA) Henkel, C. (MPIfR) Moran, J. M. (CfA) Wilson, A. S. (Maryland)	Imaging accretion disks and measuring distances to galaxies. 1.3 cm
BB217	Boyce, E. (MIT) Winn, J. (CfA) Myers, S. Rusin, D. (Pennsylvania) Hewitt, J. N. (MIT) Keeton, C. (Rutgers)	Observations of gravitational lens central images. 6 cm
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
BK127	Knudsen, K.K. (MPIfA) Walter, F. (MPIfA) Momjian, E. (Arecibo) Carilli, C. L. Yun, M. (Massachusetts)	Resolving the AGN and the starburst in an intensely starforming quasar. 21 cm
BM238	Momjian, E. (Arecibo) Carilli, C. L. Walter, F. (MPIfA) Riechers, D. (MPIfA)	Testing the AGN vs. AGN+starburst hypotheses in the z = 4.4 QSO BRI 1335-0417. 21 cm
BT075	Tarchi, A. (IRA, Bologna) Brunthaler, A. (MPIfR) Henkel, C. (MPIfR) Menten, K. M. (MPIfR) Moscadelli, L. (OAC) Chiaberge, M. (IRA, Bologna)	3C403: Is the water maser in an FRII associated with an accretion disk or due to a jet interaction? 1.3 cm

GBT Observing Programs

No.	Observer(s)	Programs
BW083	Winn, J. (CfA) Haarsma, D. (Calvin) Shapiro, I. I. (CfA) Lehar, J. (CombinatoRx)	The central component of Q0957+561. 1.3 cm
BW085	Winn, J. (CfA) Keeton, C. (Rutgers)	The missing images of the quintuple quasar. 3.5 cm
GB052	Bartel, N. (York) Bietenholz, M. F. (York) Rupen, M. P.	The expansion of the shell of SN1986J with a neutron star or black hole in its center. 6 cm
GB057	Brisken, W.F. Coles, W. A. (UC, San Diego) Macquart, J.P. Rickett, B. J. (UC, San Diego) Tingay, S. (Swiburne) West, C. (Swiburne)	Resolving scintillation arcs with VLBI. 90 cm
GBT01A-005	Turner, B. Langston, G. I.	A high-resolution spectral survey of TMC-1 at Q-Band . 7 mm
GBT02A-066	Hughes, D. H. (INAOE) Aretxaga, I. (INAOE) Gaztanaga, E. (INAOE) Chapin, E. L. (INAOE) Dunlop, J.S. (Royal Observatory) Devlin, M.J. (Pennsylvania) Wagg, J. (CfA)	Breaking the redshift deadlock: the spectroscopic redshift of HDF850.1, the brightest sub-millimetre source in the Hubble Deep Field. 7 mm
GBT03C-012	Braatz, J. A. Henkel, C. (MPIfR)	Follow-up observations of extragalactic H_2O masers discovered with the GBT. 1.3 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04B-026	Kramer, M. (Jodrell Bank) Stairs, I. (British Columbia) Camilo, F. (Columbia) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Lyne, A. G. (Jodrell Bank) Manchester, R (ATNF) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (INAF) Freire, P. (Arecibo) Joshi, B. (TIFR) Ferdman, R. (British Columbia)	Timing the first double pulsar system. 38 cm
GBT04C-029	Dyer, K. (NRL) Walter, F. (MPIfA) Rupen, M. P. Cornwell, T. J. (CSIRO)	Crossing the critical junction: star formation between 1 and 10,000 GHz. 2 cm, 6 cm
GBT04C-031	Kondratko, P.T. (CfA) Greenhill, L. J. (CfA) Moran, J. M. (CfA) Lovell, J.E.J. (ATNF) Kuiper, T. B. H. (JPL) Jauncey, D. L. (ATNF)	Monitoring of five NGC4258-like water megamasers discovered with the GBT and the DSN. 1.3 cm
GBT04C-043	Ransom, S. Freire, P. (Arecibo) Gupta, Y. (NCRA)	Timing the eccentric millisecond pulsar binary in globular cluster NGC 1851. 90 cm
GBT05A-011	Ransom, S. Camilo, F. (Columbia) Stairs, I. (British Columbia) Kaspi, V. (McGill) Hessels, J. W. T. (McGill) Freire, P. (Arecibo)	Timing of the binary and millisecond pulsars in Terzan5. 11 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05A-024	Campbell, D. B. (Cornell) Campbell, B. (Smithsonian Institution) Carter, L. (Smithsonian Institution) Margot, J.L. (Cornell) Stacy, N. (DSTO)	S-Band radar mapping of the lunar polar regions. 11 cm
GBT05A-033	Stairs, I. (British Columbia) Camilo, F. (Columbia) Kramer, M. (Jodrell Bank) Faulkner, A. (Jodrell Bank) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Lyne, A. G. (Jodrell Bank) Hobbs, G. (ATNF) Manchester,R. (ATNF) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (INAF) Ferdman, R. (British Columbia) Ramachandran, R. (UC, Berkeley) Backer, D. C. (UC, Berkeley) Demorest, P. (UC, Berkeley) Nice, D. (Princeton)	Shapiro delay in the PSR J1802-2124 system. 21 cm
GBT05A-041	Demorest, P. (UC, Berkeley) Backer, D. C. (UC, Berkeley) Ferdman, R. (British Columbia) Stairs, I. (British Columbia) Nice, D. (Princeton) Ramachandran, R. (UC, Berkeley)	Precision timing of binary and millisecond pulsars . 21 cm, 38 cm
GBT05B-002	Taylor, G.B. (New Mexico) Romani, R. W. (Stanford) Peck, A.B. (CfA) Zavala, R. (USNO)	Searching for water masers in the black hole binary system 0402+379. 1.3 cm
GBT05B-007	Minter, A.	Does pulsar scattering arise in photo-dissociation regions of molecular clouds? 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05B-008	Hollis, J. M. (GSFC) Jewell, P. R. Lovas, F. J. (NIST) Shevlin, P. (NSF) McKee, M. (Auburn) Remijan, A. (GSFC)	Searching for the missing link in sugar polymerization. 1.3 cm, 6 cm
GBT05B-011	Minter, A.	Using pulsar HI absorption to determine the distance to the local spiral arm in the second quadrant of the galaxy. 21 cm
GBT05B-023	Juett, A. (UVA) Ransom, S. Chakrabarty, D. (MIT)	A search for radio pulsations from the accreting millisecond X-ray pulsar SAX J1808.4-3658. 6 cm, 11 cm
GBT05B-032	Thorsett, S. (UC, Santa Cruz) Stairs, I. (British Columbia) Arzoumanian, Z. (GSFC)	Timing the millisecond pulsar B1620-26 with the GBT. 21 cm
GBT05B-034	Stairs, I. (British Columbia) Camilo, F. (Columbia) Kramer, M. (Jodrell Bank) Faulkner, A. (Jodrell Bank) McLaughlin, M. (Manchester) Lyne, A. G. (Jodrell Bank) Hobbs, G. (ATNF) Manchester, R. (ATNF) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (INAF) Ferdman, R. (British Columbia) 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

GBT Observing Programs

No.	Observer(s)	Programs
GBT05B-042	Kramer, M. (Jodrell Bank) Stairs, I. (British Columbia) Camilo, F. (Columbia) McLaughlin, M. (Manchester) Lyne, A. G. (Jodrell Bank) Manchester, R. (ATNF) Possenti, A. (OAC) D'Amico, N. (OAC) Burgay, M. (INAF) Freire, P. (Arecibo) Joshi, B. (TIFR) Ferdman, R. (British Columbia)	Timing and general relativity in the double pulsar system. 21 cm, 38 cm
GBT05B-044	McLaughlin, M. (Manchester) Possenti, A. (OAC) Stairs, I. (British Columbia) Kramer, M. (Jodrell Bank) Lyne, A. G. (Jodrell Bank) Lyutikov, M. (McGill) Burgay, M. (INAF) Manchester, R. (ATNF) Freire, P. (Arecibo) Camilo, F. (Columbia)	Studying the interactions in the J0737-3039 system. 90 cm
GBT05B-061	Claussen, M. J. Healy, K. (Arizona State) Bond, H. (STSI) Starrfield, S. (Arizona State)	High velocity silicon monoxide masers in V838 Monocerotis. 7 mm
GBT05C-001	Campbell, B. (Smithsonian Institution) Campbell, D. B. (Cornell) Carter, L. (Smithsonian Institution)	Radar mapping of the Moon at 70-cm wavelength using Arecibo and the GBT. 70 cm
GBT05C-002	Kavars, D. (Minnesota) Dickey, J. M. (Tasmania) Skillman, E. (Minnesota) Strasser, S.T. (Minnesota)	Extended OH emission maps of HISA clouds. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05C-005	Yun, M. (Massachusetts) Borthakur, S. (Massachusetts) Verdes-Montenegro, L. (IAA)	What happens to the stripped HI in compact groups? 21 cm
GBT05C-007	Remijan, A. (GSFC) Stork, (Parkland) Meier, D. L. (Illinois) Hollis, J. M. (GSFC) Jewell, P. R. Lovas, F. J. (NIST)	A search for interstellar cyanoformaldehyde (CNCHO). 3.5 cm
GBT05C-008	Maccarone, T. (Amsterdam) Stappers, B. (Amsterdam) Kundu, A. (Michigan State) Zepf, S. (Michigan State) Piro, A. (UC, Santa Barbara) Bildsten, L. (UC, Santa Barbara) Kaplan, D.L. (MIT)	Searching for pulsars in dwarf spheroidal galaxies. 90 cm
GBT05C-009	Joncas, G. (Laval) Bariault, L. (Laval) Boothroyd, A. (Toronto) Landecker, T. L. (DRAO) Lockman, F. J. Martin, P.G. (Toronto) Miville-Deschenes, M. (IAS) Taylor, A. R. (Calgary)	GBT HI observations of the DRAO deep field: determining foregrounds for Planck. 21 cm
GBT05C-012	Henkel, C. (MPIfR) Braatz, J. A. Ott, J. (ATNF) Mauersberger, R. (IRAM) Menten, K. M. (MPIfR)	Ammonia as a temperature probe in nearby AGNs. 1.3 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05C-014	Devine, K. (Wisconsin, Madison) Chandler, C. Brogan, C.L. (Hawaii, Manoa) Shirley, Y.L. (Arizona) Indebetouw, R. (UVA) Churchwell, E. B. (Wisconsin, Madison)	Ammonia and CCS Observations of GLIMPSE infrared dark clouds. 1.3 cm
GBT05C-015	Henkel, C. (MPIfR) Braatz, J. A. Ott, J. (ATNF) Menten, K. M. (MPIfR)	Ammonia in ultraluminous infrared galaxies. 1.3 cm
GBT05C-016	Bolatto, A. (UC, Berkeley) Darling, J. (Colorado, Boulder) Willott, C. (Herzberg Institute)	A search for HI and molecular absorption in an extremely reddened QSO. 90 cm
GBT05C-018	Robishaw, T. (UC, Berkeley) Heiles, C. E. (UC, Berkeley) Quataert, E. (UC, Berkeley)	OH megamasers in ULIRGs: the mega-obvious place to look for Zeeman splitting! 21 cm
GBT05C-020	Remijan, A. (GSFC) Hollis, J. M. (GSFC) Lovas, F. J. (NIST) Jewell, P. R. Snyder, L. E. (Illinois)	Confirmation of interstellar methyltriacetylene (CH3C6H) toward TMC-1. 1.3 cm
GBT05C-021	Miville-Deschenes, M. (IAS) Boulanger, F. (IAP) Lockman, F. J. Boothroyd, A. (Toronto) Martin, P.G. (Toronto)	Characterizing dust in high velocity clouds. 21 cm
GBT05C-022	Braatz, J. A. Henkel, C. (MPIfR)	The accretion disks and supermassive black holes in NGC 2273 and NGC 4051. 1.3 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05C-023	Camilo, F. (Columbia) Ransom, S. Gaensler, B.M. (CfA) Slane, P.O. (CfA) Lorimer, D. (Manchester) Manchester, R. (ATNF)	PSR J1833-1034, the very young pulsar in the SNR G21.5-0.9. 11 cm
GBT05C-025	Camilo, F. (Columbia) Gaensler, B.M. (CfA) Lorimer, D. (Manchester) Ransom, S.	Deep searches of six pulsar wind nebulae. 11 cm
GBT05C-026	Devlin, T. (Rutgers) Devlin, M.J. (Pennsylvania) Mason, B.S.	Polarization of 30 GHz emission from extra-galactic sources. 3.5 cm, 7 mm
GBT05C-030	Blundell, K. (Oxford) Lockman, F. J.	HI observations near SS433/W50. 21 cm
GBT05C-031	Kepley, A. (Wisconsin, Madison) Wilcots, E. (Wisconsin, Madison) Robishaw, T. (UC, Berkeley) Heiles, C. E. (UC, Berkeley) Zweibel, E. (Wisconsin, Madison)	Magnetic fields in dwarf irregular galaxies: NGC 4214. 6 cm
GBT05C-034	Kameno, S. (NAOJ) Nakai, N. (Tsukuba) Sawada-Satoh, S. (ASIAA) Sato, N. (NRO) Yoshikawa, (Tokyo)	Water maser tomography through molecular torus of NGC 1052. 1.3 cm
GBT05C-037	Kanekar, N. Carilli, C. L. Langston, G. I. Stocke, J. T. (Colorado, Boulder) Menten, K. M. (MPIfR) Rocha, G. (Cambridge)	Measuring changes in fundamental constants with redshifted OH lines. 38 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05C-038	Bower, G. C. (UC, Berkeley) Ramachandran, R. (UC, Berkeley) Muno, M. P. (UC, Los.Angeles) Baganoff, F. K. (MIT)	Searching for radio pulsations from radio point sources in the galactic center. 3.5 cm
GBT05C-040	Kasian, L. (British Columbia) Stairs, I. (British Columbia) Backer, D. C. (UC, Berkeley) Ramachandran, R. (UC, Berkeley) van Leeuwen, (British Columbia)	A drift-scan pulsar survey II. Confirmation of candidates. 90 cm
GBT05C-042	Ransom, S. Freire, P. (Arecibo) Hessels, J. W. T. (McGill) Begin, S. (British Columbia) Stairs, I. (British Columbia) Camilo, F. (Columbia) Kaspi, V. (McGill)	Timing the binary and millisecond pulsars in NGC6440 and NGC6441. 11 cm
GBT05C-043	Kanekar, N. Carilli, C. L. Stocke, J. T. (Colorado, Boulder)	A blind GBT survey for redshifted molecular absorption. 7 mm
GBT05C-044	Zweibel, E. (Wisconsin, Madison) Crutcher, R. M. (Illinois) Churchwell, E. B. (Wisconsin, Madison) Watson, D. (Wisconsin, Madison)	Physical conditions in dark filaments discovered by GLIMPSE. 21 cm
GBT05C-045	Ransom, S. Hessels, J. W. T. (McGill) Roberts, M. (McGill) Kaspi, V. (McGill)	A 350-MHz survery of the northern galactic plane for pulsars (continued). 90 cm
GBT05C-046	Stairs, I. (British Columbia) Lorimer, D. (Manchester)	Timing of a relativistic binary and other pulsars from the Arecibo PALFA survey. 21 cm
GBT05C-049	Stinebring, D. R. (Oberlin) Minter, A. Ransom, S.	Follow-on scintillation observations of two pulsars. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05C-050	Cameron, P. (Caltech) Kulkarni, S. R. (Caltech) Kaplan, D.L. (MIT)	A search for the pulsar in G70.7+1.2. 11 cm
GBT05C-051	Braatz, J. A. Gugliucci, N. (UVA)	A snapshot survey for H_2O megamasers in nearby, luminous galaxies. 1.3 cm
GBT05C-053	van Leeuwen, J. (British Columbia) Stairs, I. (British Columbia) Ferdman, R. (British Columbia) Ramachandran, R. (UC, Berkeley) Backer, D. C. (UC, Berkeley) Demorest, P. (UC, Berkeley) Nice, D. (Princeton)	Exposing drifting subpulses from the slowest to the fastest pulsars. 90 cm
GBT05C-056	Freire, P. (Arecibo Observatory) Ransom, S. Stairs, I. (British Columbia) Hessels, J. W. T. (McGill) Kaspi, V. (McGill) Camilo, F. (Columbia) Begin, S. (British Columbia)	A GBT S-band globular cluster survey: Phase B. 11 cm
GBT05C-057	Jorgenson, R. (UC, San Diego) Wolfe, A. M. (UC, San Diego) Prochaska, J. (UC, Santa Cruz) Darling, J. (Colorado, Boulder)	Search for 21cm absorption toward radio loud, extremely optically faint sources. 90 cm
GBT05C-058	Foster, G. (NRC, Canada) Kothes, R. (DRAO)	The galactic object OA184: supernova remnant or HII region? 6 cm
GBT06A-008	Minter, A.	A better approach to finding pulsars with OH absorption. 21 cm
GBT06A-044	Darling, J. (Colorado, Boulder) Stocke, J. T. (Colorado, Boulder) Willett, K. (Colorado, Boulder)	Intrinsic HI and OH absorption in compact radio sources at high redshift. 38 cm

GBT Observing Programs

No.	Observer(s)	Programs
GL028	Lonsdale, C. J. (NEROC) Diamond, P. J. (Jodrell Bank) Lonsdale, C. J. (IPAC) Smith, H. E. (UC, San Diego)	Tracing ultraluminous infrared galaxy starbursts with radio supernovae. 21 cm
GM057	Marcaide, J. M. (Universidad de Valencia) Marti-Vidal, I. (Universidad de Valencia) Guirado, J. C. (Universidad de Valencia) Alberdi, A. (IAA) Perez-Torres, M. A. (IAA) Lara, L. (Universidad de Granada) Ros, E. (MPIfR) Diamond, P. J. (Jodrell Bank) Shapiro, I. I. (CfA) Preston, R. A. (JPL) Schilizzi, R. T. (ASTRON) Mantovani, F. (IRA, Bologna) Trigilio, C. (IRA, Bologna) Van Dyk, S.D. (Caltech) Weiler, K. W. (NRL) Sramek, R. A. Whitney, A. R. (NEROC)	Monitoring the different expansions of SN1993J at 6 and 18cm. 6 cm
GV017	Kanekar, N. Vermeulen, R. (ASTRON) Chengalur, J. (NCRA) Ghosh, T. (Arecibo)	The physics of an OH megamaser at z = 0.25. 21 cm

VLA Observing Programs

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

No.	Observer(s)	Programs
AA299	Araya, E. (Puerto Rico) Hofner, P. (Puerto Rico) Goss, W. M. Kurtz, S. (Mexico/UNAM) Linz, H. (Puerto Rico) Olmi, L. (Puerto Rico)	H_2CO 6 cm emission in IRAS 22305+5803. 6 cm
AA300	Arce, H. (AMNH) Tafalla, M. (OAN) Anglada, G. (IAA, Andalucia)	Imaging ammonia cores in Perseus molecular clouds. 1.3 cm
AB1150	Birzan, L. (Ohio State) McNamara, B. (Ohio State) Carilli, C. Rafferty, D. (Ohio State) Nulsen, P. (CfA) Wise, M. (MIT)	Systems with X-ray cavities. 3.6 cm
AB1180	Bagchi, J. (IUCAA)	Spectral index imaging of the halo in Abell 523. 20 cm
AB1183	Bartkiewicz, A. (Copernicus/Torun) Szymczak, M. (Copernicus/Torun) van Langevelde, H. (JIVE)	Continuum counterpart associated with methanol ring G23.657-0.127. 0.7, 1.3 cm
AB1185	Beck, R. (MPIR, Bonn) Berkhuijsen, E. (MPIR, Bonn) Fletcher, A. (Newcastle)	Polarimetry of two regions in M31. 3.6, 6 cm
AB1186	Baker, A. (Paris Observatory) Chandler, C. Garcia-Burillo, S. (Observatory National) Lehnert, M. (Leiden)	Imaging SiO(1-0) emission from M82. 0.7 cm
AB1187	Brogan, C. (Hawaii) Kassim, N. (NRL) Lazio, T. (NRL) Nord, M. (New Mexico)	Galactic center mosaic at 330 MHz. 90 cm

VLA Observing Programs

No.	Observer(s)	Programs
AB1188	Baker, A. (Paris Observatory) O'Neil, K. (NAIC) Mulchaey, J. (Mt. Wilson) Zabludoff, A. (Wisconsin)	HI imaging of isolated early-type galaxies. 20 cm
AB1190	Birzan, L. (Ohio State) McNamara, B. (Ohio State) Carilli, C. Rafferty, D. (Ohio State) Nulsen, P. (CfA) Wise, M. (MIT)	Radio sources in clusters and a group with X-ray cavities. 3.6, 6 cm
AC768	Curiel, S. (Mexico/UNAM) Girart, J. (Barcelona) Raga, A. (Mexico/UNAM)	Proper motions of SiO emission in the L1448 outflow. 0.7 cm
AC775	Curiel, S. (Mexico/UNAM) Ho, P. (CfA) Hirano, N. (Hitotsubashi) Zhang, Q. (CfA) Girart, J. (Barcelona)	Structure and kinematics of the SiO outflow in HH211. 0.7 cm
AC782	Carilli, C. Walter, F. (MPIA) Knudsen, K. (Leiden) Riechers, D. (MPIA) Bertoldi, F. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Beelen, A. (IAP, Paris) Cox, P. (IAP, Paris) Omont, A. (IAP, Paris)	Search for CO emission from QSO J1048+4637 at z=6.2. 0.7 cm
AC786	Cohen, A. (NRL) Clarke, T. (UVA) Lane, W. (NRL) Lazio, T. (NRL) Kassim, N. (NRL)	Diffuse emission in Abell 2443. 20 cm
AC792	Choi, M. (SA/IAA, Taiwan)	SiO study of directional variability of protostellar outflows. 0.7 cm

VLA Observing Programs

No.	Observer(s)	Programs
AC793	Chandler, C. Brogan, C. (Hawaii) deGregorio-Monsalvo, I. Gomez, J. (IAA, Andalucia) Kuiper, T. (JPL)	Distribution of CCS and ammonia emission from TMC-1. 1.3 cm
AC794	Cerrigone, L. (Catania) Hora, J. (CfA) Trigilio, C. (Noto) Umana, G. (Catania)	Comparing radio and infrared properties of planetary nebulae. 1.3 cm
AC796	Chung, A. (Columbia) vanGorkom, J. (Columbia) Kenney, J. (Yale) Vollmer, B. (MPIR, Bonn) Crowl, H. (Yale) Schiminovich, D. (Caltech)	Imaging HI streamers in the Virgo Cluster. 20 cm
AC799	Curiel, S. (Mexico/UNAM) Hiriart, D. (Mexico/UNAM) Ho, P. (CfA) Patel, N. (CfA)	Tracking down the high-velocity SiO emission in high mass YSO Cep A/HW2. 0.7 cm
AC800	Carrasco, C. (IAA, Andalucia) Anglada, G. (IAA, Andalucia) Gyulbudaghian, A. (BAO, Armenia) Won Lee, C. (KAO, Korea)	An attempt to detect the exciting source of HH 30. 3.5 cm
AC801	Chatterjee, S. (CfA) Cordes, J. (Cornell) Lazio, T. (NRL)	Astrometric position for a new relativistic binary pulsar. 20 cm
AC804	Claussen, M. Healy, K. (Arizona State) Bond, H. (STScI) Starrfield, S. (ASU) Woodward, C. (Minnesota) Gehrz, R. (Minnesota) Evans, A. (Keele) Rushton, M. (Keele)	Masers in V838 Mon. 0.7, 1.3 cm

VLA Observing Programs

No.	Observer(s)	Programs
AD509	Delain, K. (Minnesota) Rudnick, L. (Minnesota)	Structure and spectra of diffuse sources not in rich clusters. 90 cm
AD515	Dedes, L. (RAIUB) Kalberla, P. (Bonn U.)	HI clumps in the outer Galactic halo. 20 cm
AD516	Devine, K. (Carleton) Chandler, C. Brogan, C. (Hawaii) Indebetouw, R. (UVA) Shirley, Y. Churchwell, E. (Wisconsin)	NH3 and CCS observations of GLIMPSE infrared dark clouds. 1.3 cm
AF426	Fey, A. (USNO) Platais, I. (Johns Hopkins) Zacharias, N. (USNO)	Spectra of radio sources in deep optical astrometric fields. 3.6, 6 cm
AF427	Finkbeiner, D. (Princeton) Miller, A. (Columbia)	20 cm continuum emission from nearby galaxies. 20 cm
AF428	Fuente, A. (Yebes Observatory) Testi, L. (Arcetri) Bachiller, R. (Yebes Observatory) Natta, A. (Arcetri)	SEDs of Herbig Be stars. 0.7, 1.3, 3.6 cm
AG700	Green, D. (Cambridge)	Young galactic SNR associated with ASCA X-ray source. 3.5 cm
AG701	Guenther, E. (Tautenburg) Schreyer, K. (Jena) Linz, H. (Puerto Rico)	Photometry of HD209458 before, during and after planetary eclipse. 6 cm
AG703	deGregorio-Monsalvo, I.(LAEFF) Chandler, C. Gomez, J. (IAA, Andalucia) Kuiper, T. (JPL)	CCS observations of protostar L1448. 1.3 cm

VLA Observing Programs

No.	Observer(s)	Programs
AG704	Gaensler, B. (CfA) Kouveliotou, C. (NASA/MSFC) Gelfand, J. (CfA) Taylor, G. Eichler, D. (Ben Gurion) Granot, J. (KIPAC) Wijers, R. (Amsterdam) Ramirez-Ruiz, E. (IAS)	Monitoring the radio afterglow of SGR 1806-20. 3.6, 6 cm
AH865	Hollis, J. (NASA/GSFC) Remijan, A. (NASA/GSFC) Boboltz, D. (USNO) Jewell, P. Lovas, F. (Illinois)	Structure of glycolaldehyde and ammonia regions in Sgr B2(N). 1.3, 2 cm
AH877	Helfand, D. (Columbia) Becker, R. (UC, Davis) White, R. (STScI)	MAGPIS: Multi-array Galactic plane imaging survey. 20 cm
AH878	Hewitt, J. (Northwestern) Yusef-Zadeh, F. (Northwestern)	Survey of 1720 MHz OH masers in the inner galaxy. 20 cm
AH882	Hofner, P. (NMIMT) Araya, E. (NMIMT) Cesaroni, R. (Arcetri) Kurtz, S. (Mexico/UNAM) Olmi, L. (Arcetri)	Expansion of hyper-compact HII regions in G10.47+0.03. 0.7 cm
AH888	Hota, A. (NCRA) Saikia, D. (NCRA)	100 kpc long radio tailed irregular galaxies in A1367. 20 cm
AH891	Hoffman, I. (Cleriq Sciences) Goss, W.M. Palmer, P. (Chicago)	Interpretation of VLBA+Y27 observation of H_2CO masers. 6 cm
AJ321	Jamrozy, M. (Krakow) Mack, K. (Bologna) Siemiginowska, A. (CfA) Stawarz, L. (CfA)	Fossil radio lobes. 20, 90 cm

VLA Observing Programs

No.	Observer(s)	Programs
AK583	Kulkarni, S. (Caltech) Soderberg, A. (Caltech) Cenko, S. (Caltech) Frail, D. Harrison, F. (Caltech) Fox, D. (MIT) Gal-Yam, A. (Tel Aviv) Moon, D-S. (Caltech) Cameron, B. (Caltech)	Gamma-ray bursts, x-ray flashes, and core collapse SNe. 0.7, 1.3, 2, 3.6, 6, 20 cm
AK611	Kurtz, S. (Mexico/UNAM) Caplan, J. (Marseille) Deharveng, L. (Marseille) Zavagno, A. (Marseille)	Non thermal ultra compact HII region at border of Sh 217. 6, 20 cm
AK612	Keto, E. (CfA)	Kinematics of NH3 in K3-50A HII region. 1.3 cm
AK614	Karovska, M. (CfA) Matthews, L.	Monitoring maser line and radio continuum fluxes of Mira. 0.7, 1.3, 3.6, 20 cm
AK616	Kepley, A. (Wisconsin) Wilcots, E. (Wisconsin) Robishaw, T. (UC, Berkeley) Heiles, C. (UC, Berkeley) Zweibel, E. (Wisconsin)	Polarimetric imaging of the dwarf irregular galaxy NGC 4214. 3.6, 6, 20 cm
AK617	Knapik, J. (Jagiell) Beck, R. (MPIR, Bonn) Chyzy, K. (Jagiell) Urbanik, M. (Jagiell)	Magnetic fields in interacting galaxies. 6, 20 cm
AK618	Kurtz, S. (Mexico/UNAM) Deharveng, L. (Marseille) Zavagno, A. (IAS, Frascati) Caplan, J. (Marseille)	Line search toward isolated HII regions. 0.7, 1.3, 20 cm
AK619	Kanekar, N. (TIFR) Carilli, C. Stocke, J. (Colorado/JILA)	43 GHz flux densities of a radio-selected sample. 0.7 cm
AK620	Kwon, W. (Illinois) Looney, L. (Illinois)	Kinematics of outflows and disks in L1448 IRS3. 0.7, 1.3 cm

VLA Observing Programs

No.	Observer(s)	Programs
AK629	Kondratko, P. (Harvard) Greenhill, L. (SAO) Moran, J. (SAO)	Discovery of water maser emission in two nearby AGN with the GBT. 1.3 cm
AL637	Laing, R. (Oxford) Hardcastle, M. (Bristol, UK) Bridle, A.	Deep polarimetry of the jets in the FRI radio galaxy 3C 296. 3.6 cm
AL652	Landt, H. (STScI) Bignall, H. (JIVE) Padovani, P. (STScI) Perlman, E. (Maryland)	A faint sample of BL Lacertae objects. 20 cm
AL659	Lazio, T. (NRL) Brogan, C. (Hawaii) Gaensler, B. (CfA) Gelfand, J. (CfA) Kassim, N. (NRL) Lazendic, J. (MIT) McClure-Griffiths, N. (ATNF)	High resolution imaging of and a search for OH masers. 18, 6 cm
AL660	Levy, L. (UNC) Rose, J. (UNC) van Gorkom, J. (Columbia)	Search for HI plumes in galaxies in Pegasus I cluster. 20 cm
AL663	Lin, Y-T. (Illinois) Huffenberger, K. (Princeton) Partridge, R. (Haverford) Mohr, J. (Illinois) Crawford, T. (Chicago)	Spectral energy distributions of radio sources in galaxy clusters. 0.7, 1.3, 3.6, 6 cm
AM794	Machalski, J. (Jagiellonian) Jamrozy, M. (RAIUB) Koziel, D. (Jagiellonian)	Mapping of radio lobes in Giant radio galaxies. 6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AM819	Maccarone, T. (Amsterdam) Brisken, W. Fender, R. (Southampton) Mendez, M. (SRON) Migliari, S. (Amsterdam) Miller-Jones, J. (Amsterdam) vanderKlis, M. (Amsterdam) Yu, W. (Illinois)	Catching the rise of an outburst of Aql X-1. 3.5, 6 cm
AM825	Morrison, G. (IPAC) Dickinson, M. (STScI) Owen, F. Bauer, F. (UVA) Koekemoer, A. (Mt. Stromlo) Mobasher, B. (STScI) Chary, R-R. (Caltech) Frayer, D. (Caltech)	Deep imaging of the GOODS northern field. 20 cm
AM831	Monnier, J. (CfA) Greenhill, L. (CfA) Tuthill, P. (Sydney) Danchi, W. (NASA/GSFC)	Monitoring the colliding wind binary WR 112. 3.6 cm
AM839	Meier, D. (UC, Los Angeles) Turner, J. (UC, Los Angeles) Tsai, C-W. (UC, Los Angeles)	Large molecules in nearby starburst galaxies. 0.7 cm
AM841	Menten, K. (MPIR, Bonn) Alcolea, J. (OAN) Schuller, F. (MPIR, Bonn)	Masers in enigmatic IRAS object 19312+1950. 0.7 cm
AM842	Morris, M. (UC, Los Angeles) Walter, F. (MPIA)	Mapping the huge HI envelope around II Zw 44. 20 cm
AO193	Olmi, L. (Puerto Rico) Hofner, P. (Puerto Rico) Cesaroni, R. (Arcetri) Araya, E. (Puerto Rico) Kurtz, S. (Mexico/UNAM)	Search for ^{13}CS from candidate disks around massive stars. 0.7 cm
AO194	Osten, R. Jayawardhana, R.	Emission from young brown dwarf SSSPM J1102-3431. 3.6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AP487	Pandian, J. (Cornell) Momjian, E. (Kentucky) Goldsmith, P. (Cornell)	HI absorption to resolve the distance ambiguity of methanol masers. 20 cm
AP495	Phan-Bao, N. (IAA) Osten, R. Lim, J. (SA/IAA, Taiwan) Martin, E. (Hawaii)	Emission from brown dwarfs. 3.6 cm
AP497	Pedelty, J. (NASA/GSFC) Mundy, L. (Maryland) Charnley, S. (SETI)	Imaging hot molecular cores in low-mass protostars. 0.7 cm
AP498	Chandler, C. Fabian, A. (IoA) Worsley, M. (IoA)	Spectral measurements of GB 1428+4217. 0.7, 1.3, 3.5 cm
AR570	Rupen, M. Mioduszewski, A. Dhawan, V.	Monitoring of and triggered response to X-ray transients. 0.7, 1.3, 2, 3.6, 6, 20 cm
AR573	Riechers, D. (MPIA) Walter, F. (MPIA) Knudsen, K. (Leiden) Carilli, C. Bertoldi, F. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Cox, P. (IAP, Paris) Weiss, A. (Bonn)	Molecular gas in QSO host galaxies at z>4. 0.7 cm
AR579	Ribo, M. (Barcelona) Ueda, Y. (JAXA/ISAS) Chaty, S. (Paris)	Simultaneous VLA/IR/Astro-E2 look at microquasar GRS 1915+105. 2, 3.6, 6, 20 cm
AR580	Riechers, D. (MPIA) Walter, F. (MPIA) Knudsen, K. (Leiden) Carilli, C. Bertoldi, F. (MPIR, Bonn) Beelen, A. (IAP, Paris) Weiss, A. (Bonn) Menten, K. (MPIR, Bonn)	Search for molecules tracing high densities in Cloverleaf QSO. 0.7, 1.3 cm

VLA Observing Programs

No.	Observer(s)	Programs
AR583	Renno, N. (Michigan) Atreya, S. (Michigan) Wong, A-S. (Michigan) dePater, I. (UC, Berkeley) Sault, R. (CSIRO) Cantor, B. (Marlin Space Sci) Delory, G. (UC, Berkeley)	Simultaneous VLA/MGS observations of Martian dust events. 0.7, 2, 20 cm
AS800	Sjouwerman, L. Messineo, M. (Leiden) Habing, H. (Leiden) Honma, M. (NAOJ) Imai, H. (NFRA)	Monitoring circumstellar SiO masers near Sgr A*. 0.7 cm
AS805	Shirley, Y. (ASU) Evans II, N. (Texas) Spitzer Legacy Team	Search for ionized gas near surprising Spitzer-Detected source, L1014-SMM1. 3.6 cm
AS846	Soderberg, A. (Caltech) Kulkarni, S. (Caltech) Frail, D. Chevalier, R. (UVA)	Type Ibc supernovae. 0.7, 1.3, 2, 3.6, 6, 20 cm
AS848	Su, Y-N. (SA/IAA, Taiwan) Liu, S. (SA/IAA, Taiwan) Lim, J. (SA/IAA, Taiwan)	Ammonia observations of Onsala 1 region. 1.3 cm
AS850	Schreyer, K. (Jena) Hofner, P. (Puerto Rico) Araya, E. (Puerto Rico) Linz, H. (Puerto Rico) Stecklum, B. (Thuringian)	CS observations of disk candidate in AFGL 490. 0.7 cm
AS854	Shankland, P. (USNO) Blank, D. (West Sydney) Boboltz, D. (USNO) Lazio, T. (NRL) White, G. (James Cook)	VLA Search for Kuiper Belt around GJ 876. 0.7, 1.3 cm

VLA Observing Programs

No.	Observer(s)	Programs
AS856	Stamatellos, D. (Cardiff) Bontemps, S. (Bordeaux Observatory) Ward-Thompson, D. (Cardiff) Whitworth, A. (Cardiff)	Young protostars in dense cores. 6 cm
AS868	Suarez, O. (IAA, Andalucia) Gomez, J. (IAA, Andalucia)	Water masers in PN 18061. 1.3 cm
AS869	Soderberg, A. (Caltech) Frail, D.	Hydrogen rich Type 1a SN near maximum. 1.3 cm
AT307	Toribio, M. (Barcelona) Solanes, J. (Barcelona) Uson, J.	Imaging HI deficient spirals on the outskirts of Virgo. 20 cm
AT312	Tripp, T. (Princeton) Yun, M. (Massachusetts) Bowen, D. (Princeton) Prochaska, J. (UC, Santa Cruz) Jenkins, E. (Princeton)	A damped Lyman alpha absorber in the outskirts of Virgo Cluster. 20 cm
AT313	Tabatabaei, F. (MPIR, Bonn) Krause, M. (CfA) Beck, R. (MPIR, Bonn) Berkhuijsen, E. (MPIR, Bonn)	Correlating MIPS and 20 cm images of M33. 20 cm
AV281	Vollmer, B. (MPIR, Bonn) Beck, R. (MPIR, Bonn) Urbanik, M. (Jagellonian) Otmianowska-Mazur, K. (Krakow) Soida, M. (Jagellonian) Chyzy, K. (Jagellonian) Kenney, J. (Yale) vanGorkom, J. (Columbia)	Polarimetric imaging of Virgo spiral galaxies. 6 cm
AV283	Verheijen, M. (Groningen) Bershady, M. (Wisconsin) Swaters, R. (Maryland) Andersen, D. (MPIA) Westfall, K. (Wisconsin)	HI imaging of spiral galaxies from Disk Mass Project. 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AV284	Vanden Bout, P. Carilli, C. Solomon, P. (SUNY) Gao, Y. (IPAC)	Search for HCN emission from high-redshift galaxies. 0.7, 1.3 cm
AV285	Verdes-Montenegro, L. (IAA, Andalucia) Yun, M. (Massachusetts) Borthakur, S. (Massachusetts)	HI distribution in Hickson compact groups. 20 cm
AV286	Vazquez-Semadeni, E. (Mexico/UNAM) Ballesteros-Paredes, J. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM) Loinard, L. (Mexico/UNAM) Gomez, J. (IAA, Andalucia) deGregorio-Monsalvo, I. Mexico/UNAM)	Ammonia kinematics in starless cores. 1.3 cm
AW641	Weiler, K. (NRL) Sramek, R. Stockdale, C. (NRL) VanDyk, S. (UC, Los Angeles) Panagia, N. (STScI) Marcaide, J. (Valencia) Lewin, W. (MIT) Pooley, D. (MIT) Immler, S. (Massachusetts) Ryder, S. (AAO)	Triggered observations of type II SNe. 1.3, 2, 3.6, 6, 20, 90 cm
AW644	Willson, R. (Tufts)	Collaborative observation of solar type III bursts. 400, 90 cm
AW658	Wijnands, R. (MIT) Rupen, M. Maccarone, T. (Brera Observatory) Fender, R. (Amsterdam)	Coordinated observations of very faint X-ray transients. 3.6, 6 cm
AW664	Wright, E. (UC, Los Angeles) Chen, X. (Shao)	Snapshots of 9 WMAP point sources. 3.6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AW666	Wang, Y. (Texas) Zhang, Q. (CfA) Rathborne, J. (Boston) Jackson, J. (Boston)	NH3 observations of two MSX dark clouds. 1.3 cm
AW669	Wyrowski, F. (MPIR, Bonn) Gibb, A. (Maryland) Hatchell, J. (MPIR, Bonn) Pillai, T. (MPIR, Bonn) Thompson, M. (Kent)	Search for ammonia toward cold cores. 1.3 cm
AW670	WIllson, R. (Tufts)	VLA-RHESSI observation of solar micro flares. 1.2, 2, 3.5 cm
AY160	Yun, M. (Massachusetts) del Olmo, A. (IAA, Andalucia) Verdes-Montenegro, L. (IAA, Andalucia)	Is there diffuse intergroup HI in Hickson compact group 40. 21 cm
AY161	Young, L. (NMIMT) Blitz, L. (UC, Berkeley) Rosolowsky, E. (CfA)	Search for HI in three Virgo cluster S0 galaxies. 20 cm
AZ161	van Zee, L. (Indiana)	HI imaging of nearby dwarf irregular galaxies. 20 cm
AZ163	Zhang, Q. (CfA) Chen, Y. (CfA) Beuther, H. (MPIR, Bonn)	SiO imaging of protostars with candidate disks. 0.7 cm
BB217	Boyce, E. Winn, J. (CfA) Myers, S. Rusin, D. (Pennsylvania) Hewitt, J. (Massachusetts) Keeton, C. (Rutgers)	Observations of gravitational lens central images. 6 cm

VLA Observing Programs

No.	Observer(s)	Programs
BC156	Claussen, M. Bond, H. (STScI) Evans, A. (Keele) Gehrz, R. (Minnesota) Healy, K. (ASU) Rushton, M. (Keele) Starrfield, S. (ASU) Woodward, C. (Minnesota)	SiO masers in V838 Monocerotis. 0.7 cm
BD109	Dougherty, S. (DRAO) Pittard, J. (Leeds) O'Connor, E. (UPEI) Beasley, A.J. Claussen, M.	Structural monitoring of colliding wind binary WR140. 1.3, 2, 3.6 cm
BD110	Dougherty, S. (DRAO) Blomme, R. (Royal Observatory) VanLoo, S. (Royal Observatory) Runacres, M.C. (Vrije) Rauw, G. (Leige)	Structure of O star Cyg OB2 No. 9. 3.6, 6, 20 cm
BE046	Edwards, P. (ISAS) Takahashi, T. (ISAS)	Hard X-ray quasar J0746+2549. 3.6 cm
BK114	Kondratko, P. (Harvard) Greenhill, L. (CfA) Moran, J. (CfA) Reid, M. (CfA)	Imaging three NGC 4258-like water megamasers. 1.3 cm
BK127	Knudsen, K. (MPIA) Walter, F. (MPIA) Momjian, E. (Arecibo) Carilli, C. Yun, M. (Massachusetts)	Imaging two submm-bright quasars at redshift 2.8. 20 cm
BM235	Moellenbrock, G. Beasley, A.J. Claussen, M. Goss, W.M.	Parallax and proper motions of galactic water masers. 1.3 cm

VLA Observing Programs

No.	Observer(s)	Programs
BM238	Momjian, E. (Arecibo) Carilli, C. Walter, F. (MPIA) Riechers, D. (MPIA)	Imaging the FIR-luminous QSO BRI 1335-0417 at redshift 4.4. 20 cm
BM239	Moscadelli, L. (Bologna) Furuya, R. (Arcetri) Claussen, M. Kitamura, Y. (ISAS, Japan) Testi, L. (Arcetri) Wootten, A. Goddi, C. (Cagliari)	Proper motions of H2O masers in YSO Serpens SMM1. 1.3 cm
BT075	Tarchi, A. (Bologna) Brunthaler, A. (JIVE) Henkel, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Moscadelli, L. (Cagliari) Chiaberge, M. (Bologna)	Water megamaser in an FRII galaxy, 3C403. 1.3 cm
BW083	Winn, J. (CfA) Haarsma, D.B. (Calvin) Shapiro, I.I. (CfA) Lehar, J. (CombinatoRx)	Spectrum of central component of lens Q0957+561. 1.3, 20 cm
BW085	Winn, J. (CfA) Keeton, C. (CombinatoRx)	Search for additional images in quintuple quasar. 3.6 cm
GB052	Bartel, N. (York) Bietenholz, M.F. (York) Rupen, M.	Shell and central source of SN 1986J. 6, 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
GM057	Marcaide, J. (Valencia) Marti-Vidal, I. (Valencia) Guirado, J.C. (Valencia) Alberdi, A. (IAA) Perez-Torres, M.A. (IAA) Lara, L. (Granada) Ros, E. (MPIR, Bonn) Diamond, P.J. (Manchester) Shapiro, I.I. (CfA) Preston, R. (JPL) Schilizzi, R. (SKA) Mantovani, F. (Bologna) Trigilio, C. (Noto) VanDyk, S.D. (IPAC) Weiler, K. (NRL) Sramek, R. Whitney, A. (Haystack)	Monitoring the expansion of SN 1993J. 6, 20 cm

VLBA Observing Programs

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

No.	Observer(s)	Program
BB184	Braatz, J. Greenhill, L. (CfA) Henkel, C. (MPIR, Bonn) Moran, J. (CfA) Wilson, A. (Maryland)	Imaging nuclear H2O masers in NGC 4388, NGC 5728 and NGC 6323. 1.3 cm
BB192	Boboltz, D. (USNO) Driebe, T. (MPIR, Bonn) Ohnaka, K. (MPIR, Bonn) Wittkowski, M. (ESO)	Return to S Ori with the VLBA and VLT1. 0.7 cm
BB213	Brisken, W. Romani, R. (Stanford)	Pulsar J0538+2817: four more epochs. 20 cm
BB215	Bartkiewicz, A. (Torun) Szymczak, M. (Torun) van Langevelde, H. (JIVE)	Nature of methanol maser ring around a young massive star. 2 cm
BB217	Boyce, E. (NMIMT) Winn, J. (CfA) Myers, S. Rusin, D. (CfA) Hewitt, J. (Massachusetts) Keeton, C.	Observations of gravitational lens central images. 6 cm
BC147	Cotton, W. D. Danchi, W. (NASA) Lacasse, M. (CfA) Ragland, S. (CfA) Schloerb, F. (Massachusetts) Townes, C. (UC, Berkeley) Traub, W. (CfA)	Observations of Miras with photospheric asymmetries. 0.7 cm
BC152	Claussen, M. Marvel, K. (AAS) Simpson, C. (Wellesley) Wilking, B. (UMSL) Wootten, H.	Parallax and proper motions of water masers. 1 cm

VLBA Observing Programs

No.	Observer(s)	Program
BC156	Claussen, M. Bond, H. (STScI) Gehrz, R. (Minnesota) Healy, K. (ASU) Starrfield, S. (ASU) Woodward, C. (Minnesota)	Observation of SiO masers in V838 Monocerotis. 0.7 cm
BD105	Dhawan, V. Fomalont, E. Lestrade, J.F. (Paris) Mioduszewski, A. Rupen, M.	Astrometry of X-ray binaries. 2, 4 cm
BD108	Dodson, R. (ISAS) Alcolea, J. (OAN) Bujarrabal, V. (OAN) Colomer, F. (OAN) Rioja, M. (OAN) Soria-Ruiz, R. (OAN)	Frequency phase transfer astrometry to align AGB star maser images. 0.3, 0.7 cm
BD109	Dougherty, S. (DRAO) Pittard, J. (Leeds) O'Connor, E. (UPEI) Beasley, A. (Caltech) Claussen, M.	Structural monitoring of colliding-wind binary WR140. 0.7, 1.3, 2, 3.6, 6, 18 cm
BD110	Dougherty, S. (DRAO) Blomme, R. (Royal Observatory Belgium) Rauw, G. (Liege) Runacres, M. (Brussels) VanLoo, S. (Royal Observatory Belgium)	Wind collision region in O star Cyg OB2 No. 9? 4, 6, 20 cm
BD111	Dougherty, S. (DRAO) Pittard, J. (Leeds) O'Connor, E. (UPEI) Williams, P. (Edinburgh)	Astrometry of wind-collision region in binary WR146. 4, 6 cm
BE043	Edwards, P. (ISAS) Snellen, I (Leiden)	Properties of Parkes half-Jy GPS galaxy sample. 13 cm

VLBA Observing Programs

No.	Observer(s)	Program
BF075	Filho, M. (Inst. de Radioastronomie) Barthel, P. (Kapteyn) Nagar, N. (Kapteyn)	Jets in composite LINER/HII nuclei. 2, 13, 5, 20 cm
BF080	Fomalont, E. Kopeikin, S. (Missouri) Lanyi, G. (JPL)	Measuring solar gravitational deflection. 0.7, 1.3 cm
BF087	Fenech, D. (Manchester) Argo, M. (Manchester) Beswick, R. (Manchester) Muxlow, T. (Manchester) Pedlar, A. (Manchester) Wills, K. (Sheffield)	Low frequency observation of compact radio sources in M82. 90 cm
BG157	deGregorio-Monsalvo, I. (LAEFF) Gomez, J.F. (LAEFF) Patel, M. (CfA)	Study of precessing jet in intermediate mass bok globule CB3. 1 cm
BH127	Hough, D. (Trinity)	Innermost jet structure in nuclei of lobe-dominated quasars 3C207 and 3C245. 1, 2, 4 cm
BH035	Harris, D.E. (SAO) Cheung, C. (MIT) Junor, W. (LANL)	Flare decay of Know 'HST-1" in the M87 Jet. 20 cm
BH133	Homan, D. (Denison) Aller, H. (Michigan) Aller, M. (Michigan) Lister, M. (Purdue) Wardle, J. (Brandeis)	Detailed spectra of parsec-scale circular polarization. 1, 2, 4 cm
BH135	Harris, D.E. (SAO) Cheung, C.D. (Massachusetts) Junor, W. (LANL)	Flare decay of Knot 'HST-1' in the M87 jet. 20 cm
BI032	Impellizzeri, V. (MPIR, Bonn) Henkel, C. (MPIR, Bonn) Roy, A. (MPIR, Bonn)	Search for a molecular torus in Cygnus A and NGC 1052. 2 cm

VLBA Observing Programs

No.	Observer(s)	Program
BK114	Kondratko, P. (CfA) Greenhill, L. (CfA) Moran, J. (CfA) Reid, M. (CfA)	Imaging three NGC 4258-like water megamasers. 1.3 cm
BK127	Knudsen, K. (Leiden) Walter, F. (MPIA) Momjian, E. (Kentucky) Carilli, C. Yun, M. (Massachusetts)	Imaging two sub mm-bright quasars at redshift 2.8. 18 cm
BK128	Kovalev, Y.	Unusual GPS quasar 0858-289. 1, 2, 4, 6, 13, 20 cm
BK129	Kameno, S. (NAOJ) Nakai, N. (Tsukuba) Sato, N. (Nobeyama) Sawada-Satoh, S. (ASIAA, Taiwan) Yoshikawa, R. (Tokyo)	Water maser tomography through molecular torus of NGC 1052. 0.7, 1, 2, 4 cm
BL123	Lister, M. (Purdue) Aller, H. (Michigan) Aller, M. (Michigan) Arshakian, T. (MPIR, Bonn) Homan, D. (Denison) Kadler, M. (MPIR, Bonn) Kellermann, K. Kovalev, Y. Lobanov, A. (MPIR, Bonn) Ros, E. (MPIR, Bonn) Vermeulen, R. (ASTRON) Zensus, J.A. (MPIR, Bonn)	MOJAVE Program. 2 cm
BL128	Loinard, L. (Mexico/UNAM) Mioduszewski, A. Rodriguez, L. (Mexico/UNAM) Torres, R. (Mexico/UNAM)	Distance to Taurus and Ophiuchus. 2, 4 cm
BL130	Lenc, E. (Swinburne) Tingay, S. (Swinburne)	High resolution investigation of powerful hotspot in nearby radio galaxy. 13, 20 cm

VLBA Observing Programs

No.	Observer(s)	Program
BL136	Loinard, L. (Mexico/UNAM) Mioduszewski, A. Rodriguez, L. (Mexico/UNAM) Torres, R. (Mexico/UNAM)	Precise distance to Taurus star-forming regions. 4 cm
BL138	Leurini, S. (MPIR, Bonn) Beuther, H. (CfA) Menten, K. (MPIR, Bonn) Moscadelli, L. (Cagliari)	Complementing thermal with H_20 and CH3 OH maser observation in massive YSO IRAS 05358+3543. 1 cm
BM224	Ma, C-J. (NASA/GSFC) Gordon, D. (NASA/GSFC) Johnston, K. (USNO) Fey, A. (USNO) Vandenberg, N. (Interferometrics) Gipson, J. (Interferometrics) Boboltz, D. (USNO) Kingham, K. (USNO) MacMillan, D. (Interferometrics) Petrov, L. (NASA/GSFC) Fomalont, E. Walker, R.	Geodesy/astrometry observations for 2005. 3.6 cm
BM227	Moscadelli, L. (Cagliari) Cesaroni, R. (Arcetri) Rioja, M. (OAN)	Ejection and deceleration of the H_20 masers in high mass protostar IRAS 20126+4104. 1 cm
BM229	Marscher, A. (Boston) Aller, M. (Michigan) D'Arcangelo, F. (Boston) Jorstad, S. (Boston) McHardy, I. (Southampton)	Probing compact jets through multi-waveband variability. 0.7 cm
BM230	Marscher, A. (Boston) McHardy, I. (Southampton) Aller, M. (Michigan) Jorstad, S. (Boston) McHardy, I. (Southampton) Wannawichian, S. (Boston)	Relation between the X-ray state and energy flow into jets of radio galaxies. 0.7 cm
BM232	Marvel, K. (AAS) Boboltz, D. (USNO)	Measuring proper motions of H_20 masers toward OH12.8-0.9. 1 cm

VLBA Observing Programs

No.	Observer(s)	Program
BM235	Moellenbrock, G. Beasley, A. Claussen, M. Goss, W.M.	Parallax and proper motions of galactic water masers. 1 cm
BM238	Momjian, E. (Kentucky) Carilli, C. Walter, F. (MPIA) Riechers, D. (MPIA)	Imaging the FIR-luminous QSO BRI 1335-0417 at redshift 4.4. 18 cm
BM240	Marscher, A. (Boston) Jorstad, S. (Boston) D'Arcangelo, F. (Boston) Gear, W. (Wales) Hagen-Thorn, V. (St. Petersburg State) Smith, P. (Arizona) Larionov, V. (Sobolev Astro. Inst.)	Blazar monitoring during a ten day submm/IR/optical campaign. 0.7 cm
BO022	Ohnaka, K. (MPIR, Bonn) Boboltz, D. (USNO) Diebe, T. (MPIR, Bonn) Murakawa, K. (MPIR, Bonn) Wittkowski, M. (ESO)	Solve the silicate carbon star puzzle. 1 cm
BP123	Perlman, E. (Maryland) Landt, H. (CfA) Padovani, P. (ESO) Rector, R. (Alaska) Stocke, J. (CASA)	Jet speeds for a new population of radio quasars. 6 cm
BR099	Ros, E. (MPIR, Bonn) Aller, H. (Michigan) Aller, M. (Michigan) Kadler, M. (MPIR, Bonn) Kerp, J. (Bonn) Kovalev, Y. Marscher, A (Boston). Weaver, K. (NASA/GSFC) Zensus, J.A. (MPIR, Bonn)	NGC 1052, Key to explore the disk-jet connection in AGN. 0.7, 1 cm

VLBA Observing Programs

No.	Observer(s)	Program
BR100	Reid, M. (CfA) Greenhill, L. (CfA) Menten, K. (MPIR, Bonn) Moscadelli, L. (Cagliari) Xu, Y. (Nanjing) Zheng, X. (Nanjing)	Spiral structure and kinematics of the Milky Way. 2 cm
BR106	Reid, M. (CfA) Menten, K. (MPIR, Bonn)	Enigmatic star VY CMa. 0.7 cm
BR110	Rector, T. (Alaska) Fassnacht, C. (STScI) Taylor, G. (UNM) Wrobel, J.	Faint radio sources in NDWFS Cetus Field. 6 cm
BS142	Sarma, A. (Kentucky) Claussen, M. Troland, T. (Kentucky)	VLBA phase referenced Zeeman effect observation Of H_20 masers in W3 IRS5. 1 cm
BS150	Savolainen, T. (Tuorla Observatory) Rastorgueva, E. (Tuorla Observatory) Takalo, L. (Tuorla Observatory) Valtaoja, E. (Tuorla Observatory) Valtonen, M. (Tuorla Observatory) Wiik, K. (Tuorla Observatory)	Multi-frequency polarimetric monitoring of next predicted outburst in OJ287. 0.3, 0.7, 1, 2, 4 cm
BS157	Savolainen, T. (Tuorla Observatory) Pain, E. (INAF) Rastorgueva, E. (Tuorla Observatory) Valtaoja, E. (Tuorla Observatory) Wiik, K. (Tuorla Observatory)	Triggered polarimetric monitoring of a blazar in outburst. 0.3, 0.7, 1, 2, 6 cm
BS161	Szymczak, M. (Torun Centre) Bartkiewicz, A. (Torun Centre) Diamond, P. (Manchester) Gerard, E. (Observatory de Paris)	Polarized OH outburst in a proto-planetary nebulae. 20 cm

VLBA Observing Programs

No.	Observer(s)	Program
BT075	Tarchi, A. (MPIR, Bonn) Brunthaler, A. (MPIR, Bonn) Henkel, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Moscadelli, L. (Bologna) Chiaberge, M. (MPIR, Bonn)	Water megamaser in an FRII galaxy, 3C 403. 1.3 cm
BT079	vanderTak, F. (MPIR, Bonn) Hachisuka, K. (MPIR, Bonn) Menten, K. (MPIR, Bonn)	Proper motions of H_20 masers in AFGL 2136. 1 cm
BV058	Vlemmings, W. (Manchester) Diamond, P. (Manchester)	Magnetic fields in the proto-stellar environment measured using H_20 masers. 1 cm
BW083	Winn, J. (CfA) Haarsma, D. (Caltech) Shapiro, I. (CfA) Lehar, J. (CfA)	Spectrum of the central component of lens Q0957+561. 1.3, 18 cm
BW085	Winn, J. (CfA) Keeton, C. (Rutgers)	Search for additional images in quintuple Quasar. 3.6 cm
GA022	Agudo, I. (IAA, Spain) Krichbaum, T. (MPIR, Bonn) Gomez, J-L. (IEEC, Barcelona) Bach, U. (MPIR, Bonn) Bremer, M. (Bristol, UK) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Polarimetric monitoring of NRAO 150. 0.3 cm
GB052	Bartel, N. (York) Bietenholz, M. (York) Rupen, M.	Shell and central source of SN 1986J. 6, 18 cm
GB055	Bondi, M. (Bologna) Carilli, C. Perez-Torres, M. (Bologna) Taylor, G. (UNM)	Structure and spectral indices in the ULIRG Mrk 273. 6, 18 cm

VLBA Observing Programs

No.	Observer(s)	Program
GB057	Brisken, W. Coles, W. (UC, San Diego) Macquart, J-P. (Groningen/Kapteyn) Rickett, B. (UC, San Diego) Tingay, S. (CSIRO) West, C. (Swinburne)	Resolving scintillation arcs of two pulsars. 90 cm
GC024	Colomer, F. (Yebes Observatory) Soria-Ruiz, R. (Yebes Observatory) Bujarrabal, V. (Yebes Observatory) Alcolea, J. (Yebes Observatory) Desmurs, J. (Yebes Observatory)	Distribution of SiO masers in AGB stars. 0.3 cm
GG061	Giovannini, G. (Bologna) Chiaberge, M. (MPIR, Bonn) Feretti, L. (Bologna) Dallacasa, D. (Bologna) Giroletti, M. (Bologna) Perez-Torres, M. (Bologna) Cotton, W.D. Lara, L. (IAA, Spain)	Structure of NGC 315 and MKN 501 at 86 GHz. 0.3 cm
GK032	Krichbaum, T. (MPIR, Bonn) Bach, U. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Monitoring Cygnus A. 0.3 cm
GK033	Krichbaum, T. (MPIR, Bonn) Graham, D. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn) Bremer, M. (Bristol, UK) Grewing, M. (IRAM)	Structural monitoring of M87. 0.3 cm
GL028	Lonsdale, C. (Haystack) Diamond, P. (Manchester) Lonsdale, C. (Caltech) Smith, H. (UC, San Diego)	Survey for radio supernovae in ULIRGs. 18 cm

VLBA Observing Programs

No.	Observer(s)	Program
GM056	Mittal, R. (MPIR, Bonn) Porcas, R. (MPIR, Bonn) Browne, I. (Manchester) Biggs, A. (Manchester)	3mm observations of gravitational lens B0218+357. 0.3 cm
GM057	Marcaide, J. (Valencia) Marti-Vidal, I. (Valencia) Guirado, J. (Valencia) Alberdi, A. (IAA, Spain) Perez-Torres, M. (Bologna) Lara, L. (IAA, Spain) Ros, E. (MPIR, Bonn) Diamond, P. (Manchester) Shapiro, I. (CfA) Preston, R. (JPL) Schilizzi, R. (NFRA) Mantovani, F. (Bologna) Trigilio, C. (Bologna) VanDyk, S. (UC, Los Angeles) Weiler, K. (NRL) Sramek, R. Whitney, A. (Haystack)	Monitoring the expansion of SN 1993J. 6, 18 cm
GP041	Pagels, A. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Structural monitoring of 3C84. 0.3 cm
GR026	Rastorgueva, E. (Moscow/SSAI) Wiik, K. (Turku) Savolainen, T. (Turku) Takalo, L. (Turku) Krichbaum, T. (MPIR, Bonn)	Monitoring the next predicted outburst in OJ287 at 86 GHz. 0.3 cm
GV017	Kanekar, N. (TIFR) Vermeulen, R. (NFRA) Chengalur, J. (TIFR) Ghosh, T. (NAIC)	OH absorption and emission at z~0.25 toward PKS 1413+135. 18 cm

VLBA Observing Programs

No.	Observer(s)	Program
GW017	Wucknitz, O. (Hamburg) Garrett, M. (NFRA) Porcas, R. (MPIR, Bonn) Mittal, R. (MPIR, Bonn) Koopmans, L. (Caltech) Biggs, A. (Manchester)	Structure of gravitational lens B0218+357 at 90 and 50 cm. 90 cm
RDV054	Braatz, J. Greenhill, L. (CfA) Henkel, C. (MPIR, Bonn) Moran, J. (CfA) Wilson, A. (Maryland)	Imaging nuclear H_2O masers in NGC 4388, NGC 5728 and NGC 6323. 1.3 cm

Personnel

NEW HIRES

Chandra, Poonam	Jansky Fellow	24-Oct-05
Ford, Pamela	Systems Administrator, Junior	01-Nov-05
Gao, Yu	Astronomer, Visiting	01-Nov-05
Haverkorn, Marijke	Jansky Fellow	01-Dec-05
Loveland, Susan	Software Engineer II	03-Oct-05
Nordstrom, Dale	Systems Administrator, Junior	01-Nov-05
Truitt, Brian	Software Engineer III	14-Nov-05
Whysong, David	NRAO Post Doc	05-Dec-05

TERMINATIONS

Chen, Hongxia	Electronics Engineer II	05-Oct-05
Delgado, Juan	Procurement and Contracts Manager	14-Oct-05
Ervine, Patricia	Accountant	22-Dec-05
Escoffier, Raymond	Electronics Engineer I	21-Dec-05
Gianopoulos, Andrea	Public Information Officer	30-Nov-05
Groppi, Christopher	Jansky Fellow	01-Oct-05
Kelly, John	Research Associate, Junior	01-Oct-05
Kovalev, Yuriy	Jansky Fellow	01-Oct-05
Peereboom, Nick	Electronics Engineer I	01-Dec-05

PROMOTIONS

Beaudet, Carla	Electronics Engineer II	01-Oct-05
Brundage, William	Electronics Engineer, Sr.	01-Oct-05
Chandler, Claire	Division Head	01-Nov-05
Holmes, Ernest	Electronics Engineer I	01-Oct-05
Plumley, Christine	Budget Manager	01-Oct-05
Ray, Jason	Electronics Engineer II	01-Oct-05

OTHER

Braatz, James	Associate Scientist/A	01-Oct-05
Hogg, David	Emeritus Scientist	01-Oct-05
Turner, Barry	Astronomer	01-Oct-05

Publications

The following publications were identified by the NRAO Library during this reporting period. These were either authored by NRAO staff or the article was based on observations using an NRAO telescope.

ABRAMOWICZ, A.; POSPIESZALSKI, M.W. "A Dielectric Resonator Elliptic Type Function Filter."

AGUDO, I.; KRICHBAUM, T.P.; BACH, U.; PAGELS, A.; GRAHAM, D.; ALEF, W.; WITZEL, A.; ZENSUS, J.A.; BREMER, M.; GREWING, M.; TERÄSRANTA, H. "Present and Future Millimeter VLBI Imaging of Jets in AGN: The Case of NRAO 150."

ALAKOZ, A.V.; SLYSH, V.I.; POPOV, M.V.; VAL'TTS, I.E. "The Brightest OH Maser in the Sky: a Flare of Emission in W75 N."

ALBERDI, A.; COLINA, L.; TORRELLES, J.M.; PANAGIA, N.; WILSON, A.S.; GARRINGTON, S.T. "Evolution of the Circumnuclear Radio Supernova SN 2000ft in NGC 7469."

AN, T.; GOSS, W.M.; ZHAO, J.-H.; HONG, X.Y.; ROY, S.; RAO, A.P.; SHEN, Z.-Q. "Simultaneous Multiwavelength Observations of Sagittarius A*"

ARCE, H.G.; LEE, C.-F.; GUETH, F.; SHEPHERD, D.; BACHILLER, R. ROSEN, A.; BEUTHER, H. "Molecular Outflows from Newborn Stars."

ARCHER, J.W. "Solid-State Sources for Low-Noise Heterodyne Receivers."

ARCHER, J.W.; CRAWFORD, M.J. JR. "A Synthesized 90-120 GHz Signal Source."

ARCHER, J.W.; FABER, M.T. "Low-Noise, Fixed Tuned, Broadband Mixer for 200-270 GHz."

ARSHAKIAN, T.G.; LOBANOV, A.P.; CHAVUSHYAN, V.H.; SHAPOVALOVA, A.I.; ZENSUS, J.A. "Observational Evidence for the Link Between the Variable Optical Continuum and the Jet of a Radio-Loud Galaxy 3C 390.3."

ATTRIDGE, J.M.; WARDLE, J.F.C.; HOMAN, D.C. "Concurrent 43 and 86 GHz Very Long Baseline Polarimetry of 3C 273."

AUDARD, M.; GÜDEL, M.; SKINNER, S.L.; BRIGGS, K.R.; WALTER, F.M.; STRINGFELLOW, G.; HAMILTON, R.T.; GUINAN, E.F. "X-Ray Spectral Variability During an Outburst in V1118 Ori."

AUGUSTO, P.; EDGE, A.C.; CHANDLER, C.J. "The Radio Properties of the cD Galaxy of Abell 2390."

BACH, U.; KRICHBAUM, T.P.; KRAUS, A.; WITZEL, A.; ZENSUS, J.A. "Space-VLBI Polarimetry of the BL Lac Object S5 0716+714: Rapid Polarization Variability in the VLBI Core."

Publications

BALSER, D.S.; BANIA, T.M.; ROOD, R.T.; WILSON, T.L. "The Cosmic Abundance of 3He: Constraints to Standard Big Bang Nucleosynthesis."

BALSER, D.S.; GOSS, W.M.; BANIA, T.M.; ROOD, R.T. "The Detection of 3He+ in a Planetary Nebula Using the VLA."

BANIA, T.M.; CHARBONNEL, C.; ROOD, R.T.; BALSER, D.S. "The Cosmic Helium-3 Abundance: Implications for Big Bang Nucleosynthesis, Stellar Evolution, and Galactic Evolution."

BANIA, T.M.; ROOD, R.T.; BALSER, D.S.; CAMPOS, C.Q. "First Epoch Observations of 3He with the Green Bank Telescope."

BASS, R.B.; LICHTENBERGER, A.W.; WEIKLE, R.; KOOI, J.W.; WALKER, C.K.; PAN, S.-K. "Ultra-Thin SOI Beam Lead Chips for Superconducting Terahertz Circuit."

BEAULIEU, S.F.; FREEMAN, K.C.; CARIGNAN, C.; LOCKMAN, F.J.; JERJEN, H. "H I Detection of Two Dwarf S0 Galaxies in Nearby Groups: ESO 384-016 and NGC 59."

BERGER, E.; KULKARNI, S.R.; FOX, D.B.; SODERBERG, A.M.; HARRISON, F.A.; NAKAR, E.; KELSON, D.D.; GLADDERS, M.D.; MULCHAEY, J.S.; OEMLER, A.; DRESSLER, A.; CENKO, S.B.; PRICE, P.A.; SCHMIDT, B.P.; FRAIL, D.A.; MORRELL, N.; GONZALEZ, S.; KRZEMINSKI, W.; SARI, R.; GAL-YAM, A.; MOON, D.-S.; PENPRASE, B.E.; JAYAWARDHANA, R.; SCHOLZ, A.; RICH, J.; PETERSON, B.A.; ANDERSON, G.; MCNAUGHT, R.; MINEZAKI, T.; YOSHII, Y.; COWIE, L.L.; PIMBBLET, K. "Afterglows, Redshifts, and Properties of Swift Gamma-Ray Bursts."

BERGER, E.; PRICE, P.A.; CENKO, S.B.; GAL-YAM, A.; SODERBERG, A.M.; KASLIWAL, M.; LEONARD, D.C.; CAMERON, P.B.; FRAIL, D.A.; KULKARNI, S.R.; MURPHY, D.C.; KRZEMINSKI, W.; PIRAN, T.; LEE, B.L.; ROTH, K.C.; MOON, D.-S.; FOX, D.B.; HARRISON, F.A.; PERSSON, S.E.; SCHMIDT, B.P.; PENPRASE, B.E.; RICH, J.; PETERSON, B.A.; COWIE, L.L. "The Afterglow and Elliptical Host Galaxy of the Short γ-ray Burst GRB 050724."

BERSANELLI, M.; AJA, B.; ARTAL, E.; BALASINI, M.; BALDAN, G.; BATTAGLIA, P.; BERNARDINO, T.; BHANDARI, P.; BLACKHURST, E.; BOSCHINI, L.; BOWMAN, R.; BURIGANA, C.; BUTLER, R.C.; CAPPELLINI, B.; CAVALIERE, F.; COLOMBO, F.; CUTTAIA, F.; DAVIS, R.; DUPAC, X.; EDGELEY, J.; D'ARCANGELO, O.; DE LA FUENTE, L.; DE ROSA, A.; FERRARI, F.; FIGINI, L.; FOGLIANI, S.; FRANCESCHET, C.; FRANCESCHI, E.; JUKKALA, P.; GAIER, T.; GALTRESS, A.; GARAVAGLIA, S.; GUZZI, P.; HERREROS, J.M.; HOYLAND, R.; HUGES, N.; KETTLE, D.; KILPELÄ, V.H.; LAANINEN, M.; LAPOLLA, P.M.; LAWRENCE, C.R.; LAWSON, D.; LEONARDI, F.; LEUTENEGGER, P.; LEVIN, S.; LILJE, P.B.; LUBIN, P.M.; MAINO, D.; MALASPINA, M.; MANDOLESI, N.; MARI, G.; MARIS, M.; MARTINEZ-GONZALEZ, E.; MEDIAVILLA, A.; MEINHOLD, P.; MENNELLA, A.; MICCOLIS, M.; MORGANTE, G.; NASH, A.; NESTI, R.; PAGAN, L.; PAINE, C.; PASCUAL, J.P.; PASIAN, F.; PECORA, M.; PEZZATI, S.; POSPIESZALSKI, M.; PLATANIA, P.; PRINA, M.; REBOLO, R.; RODDIS, N.; SABATINI, N.; SANDRI, M.; SALMON, M.J.; SEIFFERT, M.; SILVESTRI, R.; SIMONETTO, A.; SMOOT,

Publications

G.F.; SOZZI, C.; STRINGHETTI, L.; TERENZI, L.; TOMASI, M.; TUOVINEN, J.; VALENZIANO, L.; VARIS, J.; VILLA, F.; L. WADE, L.; WILKINSON, A.; WINDER, F.; ZACCHEI, A. "Planck-LFI: Instrument Design and Ground Calibration Strategy."

BEUTHER, H.; SHEPHERD, D. "Precursors of UCHII Regions and the Evolution of Massive Outflows."

BEUTHER, H.; ZHANG, Q,; GREENHILL, L.J.; REID, M.J.; WILNER, D.; KETO, E.; SHINNAGA, H.; HO, P.T.P.; MORAN, J.M.; LIU, S.-Y.; CHANG, C.-M. "Line Imaging of Orion KL at 865 μm with the Submillimeter Array."

BEUTHER, H.; ZHANG, Q.; REID, M.J.; HUNTER, T.R.; GURWELL, M.; WILNER, D.; ZHAO, J.-H.; SHINNAGA, H.; KETO, E.; HO, P.T.P.; MORAN, J.M.; LIU, S.-Y. "Submillimeter Array 440 μm/690 GHz Line and Continuum Observations of Orion KL."

BLAY, P.; RIBO, M.; NEGUERUELA, I.; TORREJON, J.M.; REIG, P.; CAMERO, A.; MIRABEL, I.F.; REGLERO, V. "Further Evidence for the Presence of a Neutron Star in 4U 2206+54. INTEGRAL and VLA Observations."

BLAZEK, J.A.; GAENSLER, B.M.; CHATTERJEE, S.; VAN DER SWALUW, E.; CAMILO, F.; STAPPERS, B.W. "The Duck Redux: An Improved Proper Motion Upper Limit for the Pulsar B1757–24 Near the Supernova Remnant G5.4–1.2."

BLOMME, R.; VAN LOO, S.; DE BECKER, M.; RAUW, G.; RUNACRES, M.C.; SETIA GUNAWAN, D.Y.A.; CHAPMAN, J.M. "Non-thermal Radio Emission from O-type Stars. I. HD 168112."

BOBOLTZ, D.A.; FEY, A.L.; CHARLOT, P.; FOMALONT, E.B.; LANYI, G.E.; ZHANG, L.D.; KQ VLBI SURVEY COLLABORATION "Extending the ICRF to Higher Radio Frequencies -- Imaging and Source Structure."

BOWER, G.C. "Imaging the Event Horizon of a Massive Black Hole: Past, Present and Future Very Long Baseline Interferometry of Sagittarius A*"

BOWER, G.C.; ROBERTS, D.A.; YUSEF-ZADEH, F.; BACKER, D.C.; COTTON, W.D.; GOSS, W.M.; LANG, C.C.; LITHWICK, Y. "A Radio Transient 0.1 Parsecs from Sagittarius A*"

BOYCE, E.R.; BOWMAN, J.D.; BOLTON, A.S.; HEWITT, J.N.; BURLES, S. "A Search for Radio Gravitational Lenses, Using the Sloan Digital Sky Survey and the Very Large Array."

BRITZEN, S.; KRICHBAUM, T.P.; STROM, R.G.; WITZEL, A.; MUXLOW, T.W.B.; MATVEENKO, L.I.; CAMPBELL, R.M.; ALEF, W.; HUMMEL, C.A.; ZENSUS, A. "Large-Scale Motion, Oscillations and a Possible Halo on the Counter-Jet Side in 1803+784."

Publications

BROCKSOPP, C.; CORBEL, S.; RUPEN, M.; SAULT, B.; TZIOUMIS, T.; DHAWAN, V.; MIODUSZEWSKI, A.; CIMO, G.; FENDER, R. "Renewed Radio Emission from GRO J1655-40."

BRUNTHALER, A.; FALCKE, H.; BOWER, G.C.; ALLER, M.F.; ALLER, H.D.; TERAESRANTA, H. "The Extreme Flare in III Zw 2: Evolution of a Radio Jet in a Seyfert Galaxy (Poster)"

BRYERTON, E.; PERCY, R.; BASS, R.; SCHULTZ, J.; OLORODE, O.; LICHTENBERGER, A.; EDISS, G.A.; PAN, S.-K.; GOLTSMAN, G.N. "Receiver Measurements of pHEB Beam Lead Mixers on 3-mm Silicon."

BRYERTON, E.; SAINI, K.; MORGAN, M.; STOGOSKI, M.; BOYD, T.; THACKER, D. "Development of Electronically Tuned Local Oscillators for ALMA."

BRYERTON, E.W.; BARYSHEV, A.; HESPER, R.; SAINI, K.; THACKER, D.L. "A 660-GHz Electronically Tunable Local Oscillator."

BRYERTON, E.W.; THACKER, D.L.; SAINI, K.S.; BRADLEY, R.F. "Wideband Low-Phase-Noise High-Power W-Band Signal Sources."

BUTTGENBACH, T.H.; MILLER, R.E.; WENGLER, M.J.; WATSON, D.M.; PHILLIPS, T.G. "A Broadband Low Noise SIS Receiver for Submillimeter Astronomy."

CAMILO, F.; RANSOM, S.M.; GAENSLER, B.M.; SLANE, P.O.; LORIMER, D.R.; REYNOLDS, J.; MANCHESTER, R.N.; MURRAY, S.S. "PSR J1833-1034: Discovery of the Central Young Pulsar in the Supernova Remnant G21.5-0.9."

CARILLI, C.L. "Radio Astronomical Probes of Cosmic Reionization and the First Luminous Sources: Probing the 'Twilight Zone'"

CARRASCO-GONZÁLEZ, C.; LÓPEZ, R.; GYULBUDAGHIAN, A.; ANGLADA, G.; LEE, C.W. "A New Radial System of Dark Globules in Monoceros."

CHANDLER, C.J.; BROGAN, C.L.; SHIRLEY, Y.L.; LOINARD, L. "IRAS 16293-2422: Proper Motions, Jet Precession, the Hot Core, and the Unambiguous Detection of Infall."

CHAO, P.C.; SMITH, P.M.; MISHRA, U.K.; PALMATEER, S.C.; HWANG, J.C.M.; POSPIESZALSKI, M.W.; BROOKS, T.; WEINREB, S. "Cryogenic Noise Performance of Quarter-Micron Gate-Length High-Electron-Mobility Transistors."

CHATTERJEE, S.; GOSS, W.M.; BRISKEN, W.F. "Radio Emission from the Double-Pulsar System J0737-3039 Revisited."

CHEN, X.; SHEN, Z.-Q.; IMAI, H.; KAMOHARA, R. "Inward Motions of the Compact SiO Masers Around VX Sagittarii."

Publications

CHIN C.C.; DERDALL D.; SEBESTA J.; JIANG F.; DINDO P.; RODRIGUES G.; BOND D.; PAN S.-K.; KERR A.R.; LAURIA E.; POSPIESZALSKI M.; ZHANG J.; CECIL T.; LICHTENBERGER A. "A Low Noise 100 GHz Sideband- Separating Receiver."

CHOI, M. "Variability of the NGC 1333 IRAS 4A Outflow: Silicon Monoxide Observations."

CIFUENTES, L.; ASTETE, E.; CRISO´TOMO, G.; SIMPSON, J.; CIFUENTES, G.; PILLEUX, M. "Corrosion and Protection of Lead Anodes in Acidic Copper Sulphate Solutions."

CLICHE, J-F.; SHILLUE, B.; LATRASSE, C.; TETU, M.; D'ADDARIO, L.R. "A High-Coherence High-Stability Laser for the Photonic Local Oscillator Distribution of the Atacama Large Millimeter Array."

CONTRERAS, M.E.; WILKIN, F.P. "Centimeter Emission in the UY Aur System."

CORNWELL, T.J. "SKA and EVLA Computing Costs for Wide Field Imaging."

CORTES, J.R.; KENNEY, J.D.P.; HARDY, E. "The Nature of the Peculiar Virgo Cluster Galaxies NGC 4064 and NGC 4424."

COTTON, W.D.; FANTI, C.; FANTI, R.; BICKNELL, G.; SPENCER, R.E. "Probing the Ionized ISM of the CSS Quasar 3C277.1."

COX, A.L.; SPARKE, L.S.; VAN MOORSEL, G. "Neutral Hydrogen in the Polar-Ring Galaxy UGC 9796."

CRESCI, G.; DAVIES, R.I.; BAKER, A.J.; LEHNERT, M.D. "Accounting for the Anisoplanatic Point Spread Function in Deep Wide-field Adaptive Optics Images."

CROSTON, J.H.; HARDCASTLE, M.J.; HARRIS, D.E.; BELSOLE, E.; BIRKINSHAW, M.; WORRALL, D.M. "An X-ray Study of Magnetic Field Strengths and Particle Content in the Lobes of FR II Radio Sources."

CURIEL, S.; HO, P.T.P.; PATEL, N.A.; TORRELLES, J.M.; RODRIGUEZ, L.F.; TRINIDAD, M.A.; CANTO, J.; HERNANDEZ, L.; GOMEZ, J.F.; GARAY, G.; ANGLADA, G. "Large Proper Motions in the Jet of the High-Mass YSO Cepheus A HW2."

D'ADDARIO, L.R. "Microwave Technology Innovations in Orbiting VLBI."

D'ADDARIO, L.R. "SIS Mixer Development at the NRAO."

DASYRA, K.M.; TACCONI, L.J.; DAVIES, R.I.; GENZEL, R.; LUTZ, D.; NAAB, T.; SANDERS, D.B.; VEILLEUX, S.; A. J. BAKER, A.J. "Probing for Evolutionary Links Between Local ULIRGs and QSOs Using NIR Spectroscopy."

Publications

DENT, W.R.F.; TORRELLES, J.M.; OSORIO, M.; CALVET, N.; ANGLADA, G. "The Circumstellar Disc Around the Herbig AeBe Star HD169142."

DODSON, R.; EDWARDS, P.G.; HIRABAYASHI, H. "Milli-arcsecond--scale Spectral Properties and Jet Motions in M87."

DUH, K.H.; LIU, S.M.J.; WANG, S.C.; KAO, M.Y.; HO, P.; SMITH, P.M.; CHAO, P.C.; POSPIESZALSKI, M.W. "InP HEMT's - Next Generation Millimeter-Wave Devices."

DUNN, R.J.H.; FABIAN, A.C.; TAYLOR, G.B. "Radio Bubbles in Clusters of Galaxies."

ECKART, A.; BAGANOFF, F.K.; SCHOEDEL, R.; MORRIS, M.; GENZEL, R.; BOWER, G.C.; MARRONE, D.; MORAN, J.M.; VIEHMANN, T.; BAUTZ, M.W.; BRANDT, W.N.; GARMIRE, G.P.; OTT, T.; TRIPPE, S.; RICKER, G.R.; STRAUBMEIER, C.; ROBERTS, D.A.; YUSEF-ZADEH, F.; ZHAO, J.H.; RAO, R. "The Flare Activity of SgrA*; New Coordinated mm to X-Ray Observations."

EDISS, G.A. "Measurements and Simulations of Overmoded Waveguide Components at 70-118 GHz, 220-330 GHz, and 610-720 GHz."

EDISS, G.A.; EFFLAND, J.E.; GRAMMER, W.; HORNER, N.; KERR, A.R.; KOLLER, D.; LAURIA, E.F.; PAN, S.-K.; SULLIVAN, M.; CARTER, M. "ALMA Band 6 Prototype Cartridge: Design and Performance."

EMERSON, D.T. "The Works of Jagadis Chandra Bose: 100 Years of Mm-Wave Research."

ESPADA, D.; BOSMA, A.; VERDES-MONTENEGRO, L.; ATHANASSOULA, E.; LEON, S.; SULENTIC, J.; YUN, M. S. "The Large Asymmetric HI Envelope of the Isolated Galaxy NGC 864 (CIG 96)"

FABER, M.T.; ARCHER, J.W. "A Very Low-Noise, Fixed-Tuned Mixer for 240-270 GHz."

FABER, M.T.; ARCHER, J.W.; MATTAUCH, R.J. "Frequency Doubler for 100 GHz."

FABIAN, A.C.; REYNOLDS, C.S.; TAYLOR, G.B.; DUNN, R.J.H. "On Viscosity, Conduction and Sound Waves in the Intracluster Medium."

FABIAN, A.C.; SANDERS, J.S.; TAYLOR, G.B.; ALLEN, S.W.; CRAWFORD, C.S.; JOHNSTONE, R.M.; IWASAWA, K. "A Very Deep Chandra Observation of the Perseus Cluster: Shocks, Ripples and Conduction."

FELDMAN, M.J.; PAN, S.-K.; KERR, A.R. "Saturation of the SIS Mixer."

Publications

FENDER, R.P.; MUXLOW, T.W.B.; GARRETT, M.A.; KOUVELIOTOU, C.; GAENSLER, B.M.; GARRINGTON, S.T.; PARAGI, Z.; TUDOSE, V.; MILLER-JONES, J.C.A.; SPENCER, R.E "Structure in the Radio Counterpart to the 2004 Dec 27 Giant Flare from SGR 1806-20."

FEY, A.L.; BOBOLTZ, D.A.; CHARLOT, P.; FOMALONT, E.B.; LANYI, G.E.; ZHANG, L.D.; THE K-Q VLBI SURVEY COLLABORATION "Extending the ICRF to Higher Radio Frequencies: First Imaging Results."

FIEDZIUSZKO, S.; POSPIESZALSKI, M.W. "Dielectric Microwave Resonators."

FILIPOVIC, D.F.; BRADLEY, R.F.; REBEIZ, G.M. "A Planar Broadband MIC Balanced Varactor Doubler Using a Novel Grounded-CPW to Slotline Transition."

FLEISHMAN, G.D. "Diffusive Synchrotron Radiation from Extragalactic Jets."

FLEISHMAN, G.D. "Generation of Emissions by Fast Particles in Stochastic Media."

FOMALONT, E.B. "Radio Astrometry: Present Status and Future."

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

FORMAN, W.; NULSEN, P.; HEINZ, S.; OWEN, F.; EILEK, J.; VIKHLININ, A.; MARKEVITCH, M.; KRAFT, R.; CHURAZOV, E.; JONES, C. "Reflections of Active Galactic Nucleus Outbursts in the Gaseous Atmosphere of M87."

FOX, D.B.; FRAIL, D.A.; PRICE, P.A.; KULKARNI, S.R.; BERGER, E.; PIRAN, T.; SODERBERG, A.M.; CENKO, S.B.; CAMERON, P.B.; GAL-YAM, A.; KASLIWAL, M.M.; MOON, D.-S.; HARRISON, F.A.; NAKAR, E.; SCHMIDT, B.P.; PENPRASE, B.; CHEVALIER, R.A.; KUMAR, P.; ROTH, K.; WATSON, D.; LEE, B.L.; SHECTMAN, S.; PHILLIPS, M.M.; ROTH, M.; MCCARTHY, P.J.; RAUCH, M.; COWIE, L.; PETERSON, B.A.; RICH, J.; KAWAI, N.; AOKI, K.; KOSUGI, G.; TOTANI, T.; PARK, H.-S.; MACFADYEN, A.; HURLEY, K.C. "The Afterglow of GRB 050709 and the Nature of the Short- Hard γ-ray Bursts."

FUENZALIDA, V.M.; CHORNIK, B.; ESPINOZA, R.; PILLEUX, M.E.; ZÁRATE, R.A.; CABRERA, A. "The Localized Hydrothermal Technique: A New Method for Growing Barium Titanate Films at Atmospheric Pressure."

GAENSLER, B.M.; KOUVELIOTOU, C.; GELFAND, J. D.; TAYLOR, G. B.; EICHLER, D.; WIJERS, R.A.M.J.; GRANOT, J.; RAMIREZ-RUIZ, E.; LYUBARSKY, Y.E.; HUNSTEAD, R.W.; CAMPBELL-WILSON, D.; VAN DER HORST, A.J.; MCLAUGHLIN, M.A.; FENDER, R.P.; GARRETT, M.A.; NEWTON-MCGEE, K.J.; PALMER, D.M.; GEHRELS, N.; WOODS, P.M. "An Expanding Radio Nebula Produced by a Giant Flare from the Magnetar SGR 1806-20."

Publications

GARRETT, M.A.; WROBEL, J.M.; MORGANTI, R. "21st Century VLBI: Deep Wide-Field Surveys."

GELFAND, J.D.; LYUBARSKY, E.; EICHLER, D.; GAENSLER, B.M.; TAYLOR, G.B.; GRANOT, J.; NEWTON-MCGEE, K.J.; RAMIREZ-RUIZ, E.; KOUVELIOTOU, C.; WIJERS, R.A.M.J. "A Rebrightening of the Radio Nebula Associated with the 2004 December 27 Giant Flare from SGR 1806-20."

GIACANI, E.; LOISEAU, N.; DUBNER, G.; SMITH, M.J.S. "Radio and X-ray Emission Associated with the Supernova Remnant G352.7-0.1."

GIROLETTI, M. "Radio Observations of a Sample of BL Lac Objects."

GITTI, M.; FERETTI, L.; SCHINDLER, S. "Multifrequency VLA Radio Observations of the X-ray Cavity Cluster of Galaxies RBS797: Evidence of Differently Oriented Jets."

GLENN, J.; WALKER, C.K.; YOUNG, E.T. "Cyclops: A Single Beam 1.3 Millimeter Polarimeter."

GLOBUS, T.; WOOLARD, D.L.; KHROMOVA, T.; PARTASARATHY, R.; MAJEWSKI, A.; ABREU, R.; HESLER, J.L.; PAN, S.-K.; EDISS, G. "Terahertz Signatures of Biological-Warfare-Agent Simulants."

GOLDEN, A.; BOURKE, S.; CLYNE, G.; BUTLER, R.F.; SHEARER, A.; MUXLOW, T.W.B.; BRISKEN, W.F. "A MERLIN Observation of PSR B1951+32 and Its Associated Plerion."

GOPAL-KRISHNA; LEDOUX, C.; MELNICK, J.; GIRAUD, E.; KULKARNI, V.; ALTIERI, B. "Optical and Radio Observations of a Sample of 52 Powerful Ultra-Steep Spectrum Radio Sources."

GRANOT, J.; RAMIREZ-RUIZ, E.; TAYLOR, G.B.; EICHLER, D.; LYUBARSKY, Y.E.; WIJERS, R.A.M.J.; GAENSLER, B.M.; GELFAND, J.D.; KOUVELIOTOU, C. "Diagnosing the outflow from the SGR 1806-20 Giant Flare with Radio Observations."

GWINN, C.R.; HIRANO, C.; BOLDYREV, S. "Interstellar Scintillation of PSR J0437-4715 on Two Scales."

HACHISUKA, K.; BRUNTHALER, A.; MENTEN, K.M.; REID, M.J.; IMAI, H.; HAGIWARA, Y.; MIYOSHI, M.; HORIUCHI, S.; SASAO, T. "Water Maser Motions in W3(OH) and a Determination of its Distance."

HARRIS, D.E.; CHEUNG, C.C.; BIRETTA, J.A.; SPARKS, W.; JUNOR, W.; PERLMAN, E.S.; WILSON, A.S. "The Outburst of HST-1 in the M87 Jet."

HELMBOLDT, J.F.; WALTERBOS, R.A.M.; BOTHUN, G.D.; O'NEIL, K. "Star Formation in H I--Selected Galaxies. II. H II Region Properties."

HENKEL, B.; PARTRIDGE, R.B. "Completing the Counts of Radio Sources at 8.5 GHz."

Publications

HESLER, J.L.; CROWE, T.W.; BISHOP, W.L.; WEIKLE, R.M. II; BRADLEY, R.F.; PAN, S.-K. "The Development of Planar Schottky Diode Waveguide Mixers at Submillimeter Wavelengths."

HESLER, J.L.; HALL, W.R.; CROWE, T.W.; WEIKLE, R.M., II; DEAVER, B.S., JR; BRADLEY, R.F.; PAN, S.-K. "Fixed- Tuned Submillimeter Wavelength Waveguide Mixers Using Planar Schottky-Barrier Diodes."

HICKS, R.; FELDMAN, M.; KERR, A. "A General Numerical Analysis of the Superconducting Quasiparticle Mixer."

HOMAN, D.C.; LISTER, M.L. "MOJAVE: Monitoring of Jets in AGN with VLBA Experiments - II. First-Epoch 15 GHz Circular Polarization Results."

HORIUCHI, S.; FOMALONT, E.B.; SCOTT, W.K.; TAYLOR, A.R.; LOVELL, J.E.J.; MOELLENBROCK, G.A.; DODSON, R.; MURATA, Y.; HIRABAYASHI, H.; EDWARDS, P.G.; GURVITS, L.I.; SHEN, Z.-Q. "The VSOP 5 GHz Active Galactic
Nucleus Survey. IV. The Angular Size/Brightness Temperature Distribution."

HUMPHREYS, E.M.L.; GREENHILL, L.J.; REID, M.J.; BEUTHER, H.; MORAN, J.M.; GURWELL, M.; WILNER, D.J.; KONDRATKO, P.T. "First Detection of Millimeter/Submillimeter Extragalactic H2O Maser Emission."

HUNT, L.K.; DYER, K.K.; THUAN, T.X. "The Radio Continuum of the Extremely Metal-Poor Blue Compact Dwarf Galaxy I Zw 18."

HYMAN, S.D.; LAZIO, T.J.W.; ROY, S.; RAY, P.S.; KASSIM, N.E. "A New Radio Detection of the Bursting Source GCRT J1745-3009."

IBRUGGER, J.; CARTER, M.; BLUNDELL, R. "A Low Noise Broadband 125-175 GHz SIS Receiver for Radioastronomy Observations."

IMAI, H.; MORRIS, M.; SAHAI, R.; HACHISUKA, K.; AZZOLLINI FELIPE, J.R. "A Measurement of the Galactic Rotation in the 4TH Quadrant."

INATANI, J.; SAKAMOTO, A.; TSUBOI, M. "Nb/A1-A10x/Nb Junctions for Millimeter-Wave Mixers."

IVISON, R.J.; SMAIL, I.; DUNLOP, J.S.; GREVE, T.R.; SWINBANK, A.M.; STEVENS, J.A.; MORTIER, A.M.J.; SERJEANT, S.; TARGETT, T.A.; BERTOLDI, F.; BLAIN, A.W.; CHAPMAN, S.C. "A Robust Sample of Submillimetre Galaxies: Constraints on the Prevalence of Dusty, High-Redshift Starbursts."

JAWORSKI, M.; POSPIESZALSKI, M.W. "An Accurate Solution of the Cylindrical Dielectric Resonator Problem."

Publications

JOHNSON, K.E.; KOBULNICKY, H.A. "The Spectral Energy Distributions of Infant Super-Star Clusters in Henize 2-10 from 7 Millimeters to 6 Centimeters."

KANEKAR, N.; CARILLI, C.L.; LANGSTON, G.I.; ROCHA, G.; COMBES, F.; SUBRAHMANYAN, R.; STOCKE, J.T.; MENTEN, K.M.; BRIGGS, F.H.; WIKLIND, T. "Constraints on Changes in Fundamental Constants from a Cosmologically
Distant OH Absorber/Emitter."

KASUGA, T.; HANDA, K.; INATANI, J.; ISHIGURO, M.; IWASHITA, H.; KANZAWA, T.; KAWABE, R.; MIYAZAWA, K.; MURATA, Y.; SAKAMOTO, A.; TSUBOI, M.; WATAZAWA, K.; YAMAJI, K.; YAMAMOTO, M. "Dual Channel All-Hard SIS Mixer Receivers of the Nobeyama Millimeter-Wave Array."

KELLERMANN, K.I. "Grote Reber (1911-2003): A Radio Astronomy Pioneer."

KELLERMANN, K.I. "Radio Astronomy in the 21st Century."

KELLERMANN, K.I. "Radio Astronomy: The Next Decade."

KERR, A.R.; PAN, S.-K.; FELDMAN, M.J. "Integrated Tuning Elements for SIS Mixers."

KERR, A.R.; PAN, S.-K.; WHITELEY, S.; RADPARVAR, M.; FARIS, S. "A Fully Integrated SIS Mixer for 75-110 GHz."

KETO, E. "Observations of Accretion onto High Mass Stars."

KETO, E.; WOOD, K. "Observations on the Formation of Massive Stars by Accretion."

KHARB, P.; SHASTRI, P.; GABUZDA, D.C. "When Less Is More: Are Radio Galaxies Below the Fanaroff-Riley Break More Polarized on Parsec Scales?"

KLOOSTERMAN, J.L.; DUNN, D.E.; DE PATER, I. "Jupiter's Synchrotron Radiation Mapped with the Very Large Array from 1981-1998."

KNIGHT, H.S.; BAILES, M.; MANCHESTER, R.N.; ORD, S.M.; JACOBY, B.A. "Green Bank Telescope Studies of Giant Pulses from Millisecond Pulsars."

KODAIRA, S.; ISHII, K.; INATANI, J.; TSUBOI, M. "High Rn Short-Weak-Link for Submillimeter Wave Mixers."

KOLLER, D.; KERR, A.R.; EDISS, G.A.; BOYD, D. "Design and Fabrication of Quartz Vacuum Windows with Matching Layers for Millimeter-Wave Receivers."

Publications

KONDRATKO, P.T.; GREENHILL, L.J.; MORAN, J.M.; LOVELL, J.E.J.; KUIPER, T.B.H.; JAUNCEY, D.L.; CAMERON, L.B.; GOMEZ, J.F.; GARCIA-MIRO, C.; MOLL, E.; DE GREGORIO-MONSALVO, I.; JIMENEZ-BAILON, E. "Discovery of Water Maser Emission in Eight AGN with 70-m Antennas of NASA's Deep Space Network."

KOVALEV, Y.Y.; KELLERMANN, K.I.; LISTER, M.L.; HOMAN, D.C.; VERMEULEN, R.C.; COHEN, M.H.; ROS, E.; KADLER, M.; LOBANOV, A.P.; ZENSUS, J.A.; KARDASHEV, N.S.; GURVITS , L.I.; ALLER, M.F.; ALLER, H.D. "Sub- milliarcsecond Imaging of Quasars and Active Galactic Nuclei. IV. Fine-Scale Structure."

KRIPS, M.; ECKART, A.; NERI, R.; POTT, J.U.; LEON, S.; COMBES, F.; GARCÍA-BURILLO, S.; HUNT, L.K.; BAKER, A.J.; TACCONI, L.J.; ENGLMAIER, P.; SCHINNERER, E.; BOONE, F. "Molecular Gas in NUclei of GAlaxies (NUGA). III. The Warped LINER NGC 3718."

LAINE, S.; KOTILAINEN, J.K.; REUNANEN, J.; RYDER, S.D.; BECK, R. "Examining the Seyfert – Starburst Connection with Arcsecond Resolution Radio Continuum Observations."

LAURIA, E.F.; KERR, A.R.; POSPIESZALSKI, M.W.; PAN, S.-K.; EFFLAND, J.E.; LICHTENBERGER, A.W. "A 200-300 GHz SIS Mixer-Preamplifier with 8 GHz IF Bandwidth."

LICHTENBERGER, A.W.; MCCLAY, C.P.; MATTAUCH, R.J.; FELDMAN, M.J.; PAN, S.-K.; KERR, A.R. "Fabrication of Nb/Al-Al2O3/Nb Junctions with Extremely Low Leakage Currents."

LIM, J.; TAKAKUWA, S. "Circumstellar/Protoplanetary Disks and Bipolar Jets at 5 AU Resolution."

LISZT, H.S. "Measuring Interstellar Gas-Phase D/H Ratios in the Presence of H2."

LISZT, H.S. "The Velocity Field of Ionized Gas Near Sgr A*"

LO, K.Y. "Mega-Masers and Galaxies."

LORIMER, D.R.; STAIRS, I.H.; FREIRE, P.C.C.; CORDES, J.M.; CAMILO, F.; FAULKNER, A.J.; LYNE, A.G.; NICE, D.J.; RANSOM, S.M.; ARZOUMANIAN, Z.; MANCHESTER, R.N.; CHAMPION, D.J.; VAN LEEUWEN, J.; MCLAUGHLIN, M.A.; RAMACHANDRAN, R.; HESSELS, J.W.T.; VLEMMINGS, W.; DESHPANDE, A.A.; BHAT, N.D.R.; CHATTERJEE, S.; HAN, J.L.; GAENSLER, B.M.; KASIAN, L.; DENEVA, J.S.; REID, B.; LAZIO, T.J.W.; KASPI, V.M.; CRAWFORD, F.; LOMMEN, A.N.; BACKER, D.C.; KRAMER, M.; STAPPERS, B.W.; HOBBS, G.B.; POSSENTI, A.; D'AMICO, N.; BURGAY, M. "Arecibo Pulsar Survey Using ALFA. II. The Young, Highly Relativistic Binary Pulsar J1906+0746."

MACQUART, J.-P.; BOWER, G.C. "Understanding the Radio Variability of SGR A*"

MACQUART, J.-P.; DE BRUYN, A.G. "Diffractive Interstellar Scintillation of the Quasar J1819+3845 at 21 cm."

Publications

MAJ, S.; POSPIESZALSKI, M.W. "A Composite Multilayered Cylindrical Dielectric Resonator."

MARECKI, A.; KUNERT-BAJRASZEWSKA, M.; SPENCER, R.E. "FIRST-based Survey of Compact Steep Spectrum Sources, III. MERLIN and VLBI Observations of Subarcsecond-scale Objects."

MATTHEWS, L.D.; KAROVSKA, M. "First Resolved Images of the Mira AB Symbiotic Binary at Centimeter Wavelengths."

MEHRINGER, D.M.; PALMER, P.; GOSS, W.M. "OH and H2O Masers in Sagittarius B1: Evidence for Ongoing Star Formation."

MIDDELBERG, E.; ROY, A.L.; WALKER, R.C.; FALCKE, H. "VLBI Observations of Weak Sources Using Fast Frequency Switching."

MINTER, A.H.; BALSER, D.S.; KARTALTEPE, J.S. "Limits on Turbulent H I Fluctuations Toward PSR B0329+54 on Scales Between 0.0025 and 12.5 AU."

MIYOSHI, M.; IMAI, H.; NAKASHIMA, J.; DEGUCHI, S.; SHEN, Z.-Q. "VLBA Observation of a Radio Intraday Flare of Sgr A*"

MORGAN, M. "Custom GaAs and InP Components for Radio Astronomy."

MORGAN, M.; BRYERTON, E.; CESARANO, P.; BOYD, T.; THACKER, D.; SAINI, K.; WEINREB, S. "A Millimeter- Wave Diode-MMIC Chipset for Local Oscillator Generation in the ALMA Telescope."

MORGAN, M.; WADEFALK, N.; WEINREB, S. "A Wideband MMIC LNA for the 11 to 34 GHz Band."

MORGAN, M.; WEINREB, S. "Techniques for the Integration of High-Q Millimeter-Wave Filters in Multi-Function MMIC Modules."

MOSCADELLI, L.; TESTI, L.; FURUYA, R.S.; GODDI, C.; CLAUSSEN, M.; KITAMURA, Y.; WOOTTEN, A. "First Results from a VLBA Proper Motion Survey of H2O Masers in Low-Mass YSOs: the Serpens Core and RNO 15-FIR."

MUNO, M.P.; BELLONI, T.; DHAWAN, V.; MORGAN, E.H.; REMILLARD, R.A.; RUPEN, M.P. "A Lack of Radio Emission from Neutron Star Low Mass X-ray Binaries."

NAPIER, P.J. "The Large Synthesis Radio Telescopes of the National Radio Astronomy Observatory."

NORROD, R.D.; SRIKANTH, S.; BALISTER, M. "Receiver and Optics Designs for the 100-Meter Green Bank Telescope."

OSTEN, R.A.; BASTIAN, T.S. "Wideband Spectroscopy of Two Radio Bursts on AD Leonis."

Publications

OVERZIER, R.A.; HARRIS, D.E.; CARILLI, C.L.; PENTERICCI, L.; ROTTGERING, H.J.A.; MILEY, G.K. "On the X-ray Emission of z ~ 2 Radio Galaxies: IC Scattering of the CMB and No Evidence for Fully-Formed Potential Wells."

OWEN, F.N.; KEEL, W.C.; WANG, Q.D.; LEDLOW, M.J.; MORRISON, G.E. "A Deep Radio Survey of Abell 2125 III: The Cluster Core - Merging and Stripping."

OYABU, S.; YUN, M.S.; MURAYAMA, T.; SANDERS, D.B.; KAWARA, K.; TANIGUCHI, Y.; VEILLEUX, S.; OKUDA, H.; MATSUHARA, H.; COWIE, L.L.; SATO, Y.; WAKAMATSU, K.; SOFUE, Y. "Optical Identification of Infrared Space Observatory Far-Infrared Sources in the Lockman Hole Using a Deep Very Large Array 1.4 Ghz Continuum Survey."

PALMER, P.; GOSS, W.M. "Very Large Array Observations of Broad 6-cm Excited-State OH Lines in W49A."

PAN, S.-K.; KERR, A.R.; FELDMAN, M.J.; KLEINSASSER, A.; STASIAK, J.; SANDSTROM, R.L.; GALLAGHER, W.J. "SIS Technology Boosts Sensitivity of MM-Wave Receivers."

PAN, S.-K.; KERR, A.R.; FELDMAN, M.J.; KLEINSASSER, A.W.; STASIAK, J.; SANSTROM, R.L.; GALLAGHER, W.J. "An SIS Mixer for 85-116 GHz Using Inductively Shunted Edge-Junctions."

PAN, S.-K.; KERR, A.R.; POSPIESZALSKI, M.W.; LAURIA, E.F.; CRADY, W.K.; HORNER, N.J.; SRIKANTH, S.; BRYERTON, E.; CUNNINGHAM, C.T.; CLAUDE, S.M.X.; CHIN, C.-C.; ZHANG, J.Z.; LICHTENBERGER, A.W. "An 84- 116 GHz Fixed-Tuned Integrated SIS Mixer-Preamplifier with Ultra-Wide-Band IF and Quantum-Limited Sensitivity."

PAULS, T.A.; YOUNG, J.S.; COTTON, W.D.; MONNIER, J.D. "A Data Exchange Standard for Optical (Visible/IR) Interferometry."

PÉREZ-TORRES, M.A.; ALBERDI, A.; MARCAIDE, J.M.; GUERRERO, M.A.; LUNDQVIST, P.; SHAPIRO, I.I.; ROS, E.; LARA, L.; GUIRADO, J.C.; WEILER, K.W.; STOCKDALE, C.J. "High-Resolution Observations of SN 2001gd in NGC 5033."

PÉREZ-TORRES, M.-A.; DE BREUCK, C. "The Extremely Asymmetric Radio Structure of the z=3.1 Radio Galaxy B3 J2330+3927."

PERRIN, G.; RIDGWAY, S.T.; MENNESSON, B.; COTTON, W.D.; WOILLEZ, J.; VERHOELST, T.; SCHULLER, P.; COUDE DU FORESTO, V.; TRAUB, W.A.; MILLAN-GABET, R.; LACASSE, M.G. "Unveiling Mira Stars Behind the Molecules. Confirmation of the Molecular Layer Model with Narrow Band Near-Infrared Interferometry."

PINER, B.G.; BHATTARAI, D.; EDWARDS, P.G.; JONES, D.L. "The Fastest Relativistic Jets: VLBA Observations of Blazars with Apparent Speeds Exceeding 25c."

Publications

PORTERFIELD, D.W.; CROWE, T.W.; BRADLEY, R.F.; ERICKSON, N.R. "An 80/160 GHz Broadband, Fixed-Tuned Balanced Frequency Doubler."

POSPIESZALSKI, M.W. "Comments on "Simultaneous Determination of Transistor Noise, Gain, and Scattering Parameters for Amplifier Design Through Noise Figure Measurement Only""

POSPIESZALSKI, M.W. "Cryogenically-Cooled, HFET Amplifiers and Receivers: State-of-the-Art and Future Trends."

POSPIESZALSKI, M.W. "Cylindrical Dielectric Resonators and Their Application in TEM-line Microwave Circuits."

POSPIESZALSKI, M.W. "A Dielectric Post Resonator."

POSPIESZALSKI, M.W. "Extremely Low-Noise Amplification with Cryogenic FETs & HFETs: 1970-2004."

POSPIESZALSKI, M.W. "Low-Noise, Cryogenically-Coolable Amplifiers and Receivers Using AlInAs/GaInAs/InP HEMT's - A Review."

POSPIESZALSKI, M.W. "Measurements of Complex Permittivity of Microwave Insulators by the Dielectric Resonator Method."

POSPIESZALSKI, M.W. "Millimeter-Wave, Cryogenically-Coolable, Low-Noise HFET Amplifiers: State-of-the-Art and Future Trends."

POSPIESZALSKI, M.W. "Modeling of Noise Parameters of FET's and MODFET's and Their Frequency Dependence."

POSPIESZALSKI, M.W. "Modeling of Noise Properties of MESFET's and HEMT's."

POSPIESZALSKI, M.W. "On the Theory and Application of the Dielectric Post Resonator."

POSPIESZALSKI, M.W. "Recent Advances in Cryogenically-Cooled Amplifiers and Receivers for 1 to 50 GHz Range."

POSPIESZALSKI, M.W.; LAKATOSH, W.J.; NGUYEN, L.D.; LUI, M.; LIU, T.; LE, M.; THOMPSON, M.A.; DELANEY, M.J. "Q- and E-Band Cryogenically-Coolable Amplifiers Using AlInAs/GaInAs/InP HEMT's."

POSPIESZALSKI, M.W.; LAKATOSH, W.J.; WOLLACK, E.; NGUYEN, L.D.; LE, M.; LUI, M.; KIU, T. "Millimeter-Wave Waveguide-Bandwidth Cryogenically-Coolable InP HEMT Amplifiers."

Publications

POSPIESZALSKI, M.W.; NGUYEN, L.D.; LUI, M.; LIU, T.; THOMPSON, M.A.; DELANEY, M.J. "Very Low Noise and Low Power Operation of Cryogenic AlInAs/GaInAs/InP HFET's."

POSPIESZALSKI, M.W.; NIEDZWIECKI, A.C. "FET Noise Model and On-Wafer Measurement of Noise Parameters."

POSPIESZALSKI, M.W.; WEINREB, S. "FET's and HEMT's at Cryogenic Temperatures - Their Properties and Use in Low-Noise Amplifiers."

POSPIESZALSKI, M.W.; WEINREB, S.; CHAO, P.C.; MISHRA, U.K.; PALMATEER, S.C.; SMITH, P.M.; HWANG, J.C.M. "Noise Parameters and Light Sensitivity of Low-Noise, High-Electron Mobility Transistors at 300 and 12.5 K."

POSPIESZALSKI, M.W.; WOLLACK, E.J. "Characteristics of Broadband InP HFET Millimeter-Wave Amplifiers and Their Applications in Radio Astronomy Receivers."

POSPIESZALSKI, M.W.; WOLLACK, E.J. "Ultra-Low-Noise, InP Field-Effect Transistor Radio Astronomy Receivers: State-of-the-Art."

POULSEN, A.J.; JEFFS, B.D.; WARNICK, K.F.; FISHER, J.R. "Programmable Real-Time Cancellation of GLONASS Interference with the Green Bank Telescope."

PUNSLY, B.; RODRÍGUEZ, L.F.; TINGAY, S.J.; CELLONE, S.A. "PKS 1622-253: A Weakly Accreting, Powerful Gamma- Ray Source."

RADZIWILL, N.M. "An Ethical Theory for the Advancement of Professionalism in Software Engineering."

RADZIWILL, N.M.; SHELTON, A.L. "Push for Cheese – A Metaphor for Software Usability."

RAITERI, C.M.; VILLATA, M.; IBRAHIMOV, M.A.; LARIONOV, V.M.; KADLER, M.; ALLER, H.D.; ALLER, M.F.; KOVALEV, Y.Y.; LANTERI, L.; NILSSON, K.; PAPADAKIS, I.E.; PURSIMO, T.; ROMERO, G.E.; TERASRANTA, H.; TORNIKOSKI, M.; ARKHAROV, A.A.; BARNABY, D.; BERDYUGIN, A.; BOETTCHER, M.; BYCKLING, K.; CARINI, M.T.; CAROSATI, D.; CELLONE, S.A.; CIPRINI, S.; COMBI, J.A.; CRAPANZANO, S.; CROWE, R.; DI PAOLA, A.; DOLCI, M.; FUHRMANN, L.; GU, M.; HAGEN-THORN, V.A.; HAKALA, P.; IMPELLIZZERI, V.; JORSTAD, S.; KERP, J.; KIMERIDZE, G.N.; KOVALEV, YU.A.; KRAUS, A.; KRICHBAUM, T.P.; KURTANIDZE, O.M.; LAHTEENMAKI, A.; LINDFORS, E.; MINGALIEV, M.G.; NESCI, R.; NIKOLASHVILI, M.G.; OHLERT, J.; ORIO, M.; OSTORERO, L.; PASANEN, M.; PATI, A.; POTEET, C.; ROS, E.; ROS, J.A.; SHASTRI, P.; SIGUA, L.A.; SILLANPAA, A.; SMITH, N.; TAKALO, L.O.; TOSTI, G.; VASILEVA, A.; WAGNER, S.J.; WALTERS, R.; WEBB, J.R.; WILLS, W.; WITZE, A.; XILOURIS, E. "The WEBT Campaign to Observe AO 0235+16 in the 2003-2004 Observing Season. Results from Radio-To- Optical Monitoring and XMM-Newton Observations."

Publications

RAJGURU, N.; MYERS, S.T.; BATTYE, R.A.; BOND, J.R.; CLEARY, K.; CONTALDI, C.R.; DAVIES, R.D.; DAVIS, R.J.; DICKINSON, C.; GENOVA-SANTOS, R.; GRAINGE, K.; HAFEZ, Y.A.; HOBSON, M.P.; JONES, M.E.; KNEISSL, R.; LANCASTER, K.; LASENBY, A.; MASON, B.S.; PEARSON, T.J.; POOLEY, G.G.; READHEAD, A.C.S.; REBOLO, R.; ROCHA, G.; RUBINO-MARTIN, J.A.; SAUNDERS, R.D.E.; SAVAGE, R.S.; SCAIFE, A.; SCOTT, P.F.; SIEVERS, J.L.; SLOSAR, A.; TAYLOR, A.C.; TITTERINGTON, D.; WALDRAM, E.; WATSON, R.A.; WILKINSON, A. "Cosmic Microwave Background Observations from the Cosmic Background Imager and Very Small Array: A Comparison of Coincident Maps and Parameter Estimation Methods."

REMIJAN, A.J.; HOLLIS, J.M. "IRAS 16293-2422: Evidence for Infall onto a Counter-Rotating Protostellar Accretion Disk."

REMIJAN, A.J.; HOLLIS, J.M.; LOVAS, F.J.; PLUSQUELLIC, D.F.; JEWELL, P.R. "Interstellar Isomers: The Importance of Bonding Energy Differences."

RENAUD, M.; PARON, S.; TERRIER, R.; LEBRUN, F.; DUBNER, G.; GIACANI, E.; BYKOV, A. "G0.57-0.018: A Young Supernova Remnant? INTEGRAL and VLA Observations."

REYNOLDS, S.P.; BORKOWSKI, K.J.; GAENSLER, B.M.; REA, N.; MCLAUGHLIN, M.; POSSENTI, A.; ISRAEL, G.; BURGAY, M.; CAMILO, F.; CHATTERJEE, S.; KRAMER, M.; LYNE, A.; STAIRS, I. "Discovery of the X-ray Counterpart to the Rotating Radio Transient J1819–1458."

RICHTER, P.; WESTMEIER, T.; BRÜNS, C. "Low-column Density Gas Clumps in the Halo of the Milky Way."

RODRIGUEZ, L.F.; TORRELLES, J.M.; RAGA, A.C.; CANTO′, J.; CURIEL, S.; GARAY, G. "Proper Motions in Cepheus A."

ROMANI, R.W.; NG, C.-Y.; DODSON, R.; BRISKEN, W. "The Complex Wind Torus and Jets of PSR B1706-44."

RUDNICK, L.; DELAIN, K.M.; LEMMERMAN, J.A. "Unbiased Studies of Diffuse Extragalactic Radio Sources."

RUPEN, M.P.; DHAWAN, V.; MIODUSZEWSKI, A.J. "On-Going Radio Observations of GRO J1655-40."

RUPEN, M.P.; MIODUSZEWSKI, A.J.; DHAWAN, V. "Radio Observations of XTE J1739-285."

SAIKIA, D.J.; KONAR, C.; KULKARNI, V.K. "J0041+3224: A New Double-Double Radio Galaxy."

SAMBRUNA, R.; GLIOZZI, M.; DONATO, D.; MARASCHI, L.; TAVECCHIO, F.; C.C. CHEUNG, C.C.; URRY, M.; WARDLE, J.F.C. "Deep Chandra and Multicolor HST Follow-up of the Jets in Two Powerful Radio Quasars."

Publications

SAMOSKA, L.; BRYERTON, E.; MORGAN, M.; THACKER, D.; SAINI, K.; BOYD, T.; PUKALA, D.; PERALTA, A.; HU, M.; SCHMITZ, A. "Medium Power Amplifiers Covering 90-130 GHz for the ALMA Telescope Local Oscillators."

SARMA, A.P.; MOMJIAN, E.; TROLAND, T.H.; CRUTCHER, R.M. "Very Large Array H I Zeeman Observations of NGC 1275 (Perseus A)"

SARMA, A.P.; TROLAND, T.H.; CRUTCHER, R.M.; ROBERTS, D.A. "Magnetic Fields in Shocked Regions: Very Large Array Observations of H2O Masers."

SARMA, A.P.; TROLAND, T.H.; ROMNEY, J.D. "VLBA Magnetic Field Observations in Star Forming Regions."

SCHINNERER, E. "Gas, Stars and Dust in the Spiral Arms of M51 (Poster)"

SCHULTZ, J.; WALKER, C.; LICHTENBERGER, A.; WEIKLE, R.; LYONS, C.; BASS, R.; BRYERTON, E.; PAN, S.-K.; GROPPI, C.; KOOI, J. "Application of Ultra-Thin Silicon Technology to Submillimeter Detection and Mixing."

SEIELSTAD, G.A.; LOCKMAN, F.J. "The Green Bank Telescope."

SHEN, Z.-Q.; LO, K.Y.; LIANG, M.-C.; HO, P.T.P.; ZHAO, J.-H. "A Size of ~1 AU for the Radio Source Sgr A* at the Centre of the Milky Way."

SHEPHERD, D.S. "Massive Star Outflows."

SHEPHERD, D.S. "New Views of Star Birth."

SHEPHERD, D.S. "A Young Star Yields to Subaru's Infrared Eye."

SHETH, K.; VOGEL, S.N.; REGAN, M.W.; THORNLEY, M.D.; TEUBEN, P.J. "Secular Evolution via Bar-Driven Gas Inflow: Results from BIMA SONG."

SHIELDS, G.A.; MENEZES, K.L.; MASSART, C.A.; VANDEN BOUT, P. "The Black Hole - Bulge Relationship for QSOs at High Redshift."

SHIMOIKURA, T.; KOBAYASHI, H.; OMODAKA, T.; DIAMOND, P.J.; MATVEYENKO, L.I.; FUJISAWA, K. "VLBA Observations of a Bursting Water Maser in Orion KL."

SIEGEL, P.H.; KERR, A.R. "The Measured and Computed Performance of a 140--220 GHz Schottky Diode Mixer."

Publications

SIEMIGINOWSKA, A.; BECHTOLD, J.; ALDCROFT, T.L.; ELVIS, M.; HARRIS, D.E.; DOBRZYCKI, A. "Chandra Discovery of a 300 Kiloparsec X-ray Jet in the Gigahertz-Peaked Spectrum Quasar PKS 1127-145."

SIEMIGINOWSKA, A.; CHEUNG, C.C.; LAMASSA, S.; BURKE, D.; ALDCROFT, T.L.; BECHTOLD, J.; ELVIS, M.; WORRALL, D.M. "AGN Feedback and Evolution of Radio Sources: Discovery of an X-ray Cluster Associated with z=1 Quasar."

SIEMIGINOWSKA, A.; CHEUNG, C.C.; LAMASSA, S.; BURKE, D.J.; ALDCROFT, T.L.; BECHTOLD, J.; ELVIS, M.; WORRALL, D.M. "X-ray Cluster Associated With the z = 1.063 CSS Quasar 3C 186: The Jet is Not Frustrated."

SILICH, S.; LOZINSKAYA, T.; MOISEEV, A.; PODORVANUK, N.; ROSADO, M.; BORISSOVA, J.; VALDEZ- GUTIERREZ, M. "On the Neutral Gas Distribution and Kinematics in the Dwarf Irregular Galaxy IC 1613."

SIMON, J.D.; BLITZ, L.; COLE, A.A.; WEINBERG, M.D.; COHEN, M. "The Cosmological Significance of High-Velocity Cloud Complex H."

SJOUWERMAN, L.O.; MESSINEO, M.; HABING, H.J. "43 GHz SiO Maser and Astrometry with VERA in the Galactic Center."

SJOUWERMAN, L.O.; MIODUSZEWSKI, A.J.; GREISEN, E.W. "NRAO's VLBA Data Calibration Pipeline."

SNYDER, L.E.; LOVAS, F.J.; HOLLIS, J.M.; FRIEDEL, D.N.; JEWELL, P.R.; REMIJAN, A.; ILYUSHIN, V.V.; ALEKSEEV, E.A.; DYUBKO, S.F. "A Rigorous Attempt to Verify Interstellar Glycine."

SODERBERG, A.M.; FRAIL, D.A. "Radio Observations of SN 2005gj."

SODERBERG, A.M.; KULKARNI, S.R.; PRICE, P.A.; FOX, D.B.; BERGER, E.; MOON, D.-S.; CENKO, S.B.; GAL-YAM, A.; FRAIL, D.A.; CHEVALIER, R.A.; COWIE, L.; DA COSTA, G.S.; MACFADYEN, A.; MCCARTHY, P.J.; NOEL, N.; PARK, H.S.; PETERSON, B.A.; PHILLIPS, M.M.; RAUCH, M.; REST, A.; RICH, J.; ROTH, K.; ROTH, M.; SCHMIDT, B.P.; SMITH, R.C.; WOOD, P.R. "An HST Study of the Supernovae Accompanying GRB 040924 and GRB 041006."

SOKOLOSKI, J.L.; KENYON, S.J.; ESPEY, B.R.; KEYES, C.D.; MCCANDLISS, S.R.; KONG, A.K.H.; AUFDENBERG, J.P.; FILIPPENKO, A.V.; LI, W.; BROCKSOPP, C.; KAISER, C.R.; CHARLES, P.A.; RUPEN, M.P.; STONE, R.P.S. "A "Combination Nova" Outburst in Z Andromedae: Nuclear Shell Burning Triggered by a Disk Instability."

SOLLINS, P.K.; ZHANG, Q.; KETO, E.; HO, P.T.P. "An Infalling Torus of Molecular Gas Around the Ultracompact H II Region G28.20-0.05."

Publications

SPENCER, R.; MCCOOL, R.; ANDERSON, B.; BROWN, D.; BENTLEY, M. "ALMA and e-MERLIN Data Transmission Systems: Lessons for SKA."

SPITLER, L.G.; SPANGLER, S.R. "Limits on Enhanced Radio Wave Scattering by Supernova Remnants."

STANGHELLINI, C.; O'DEA, C.P.; DALLACASA, D.; CASSARO, P.; BAUM, S.A.; FANTI, R.; FANTI, C. "Extended Emission Around GPS Radio Sources."

STIL, J.M.; LOCKMAN, F.J.; TAYLOR, A.R.; DICKEY, J.M.; KAVARS, D.W.; MARTIN, P.G.; ROTHWELL, T.A.; BOOTHROYD, A.; MCCLURE-GRIFFITHS, N.M. "Compact H I Clouds at High Forbidden Velocities in the Inner Galaxy."

STOCKDALE, C.J.; MADDOX, L.A.; COWAN, J.J.; PRESTWICH, A.; KILGARD, R.; IMMLER, S.; KRAUSS, M. "A Radio and X-Ray Study of Historical Supernovae in M83."

SUGIMOTO, M.; SEKIMOTO, Y.; TATEMATSU, K.; KAMBA, T.; TOBA, H.; YOKOGAWA, S.; OKUDA, T.; KOHNO, K. NOGUCHI, T.; YAMAGUCHI, N.; KANDORI, R.; MURAOKA, K. "Cartridge Type 800 GHz Receiver for the Atacama Submillimeter Telescope Experiment (ASTE)"

TAVECCHIO, F.; MARASCHI, L.; SAMBRUNA, R.M.; GLIOZZI, M.; CHEUNG, C.C.; WARDLE, J.F.C.; URRY, C.M. "Deceleration from Entrainment in the Jet of the Quasar 1136-135?"

TAYLOR, G.B.; GELFAND, J.D.; GAENSLER, B.M.; GRANOT, J.; KOUVELIOTOU, C.; FENDER, R.P.; RAMIREZ-RUIZ, E.; EICHLER, D.; LYUBARSKY, Y.E.; GARRETT, M.; WIJERS, R.A.M.J. "The Growth, Polarization, and Motion of the Radio Afterglow from the Giant Flare from SGR 1806-20."

TAYLOR, G.B.; SANDERS, J.S.; FABIAN, A.C.; ALLEN, S.W. "The Low-Power Nucleus of PKS 1246-410 in the Centaurus Cluster."

TAYLOR, V.A.; JANSEN, R.A.; WINDHORST, R.A.; ODEWAHN, S.C.; HIBBARD, J.E. "UBVR and Hubble Space Telescope Mid-Ultraviolet and Near-Infrared Surface Photometry and Radial Color Gradients of Late-Type, Irregular, and Peculiar Galaxies."

THOMPSON, A.R. "The Millimeter Array."

TONG, C.E.; BLUNDELL, R.; MEGARIAN, K.G.; STERN, J.A.; PAN, S.-K.; POSPIESZALSKI, M.W. "A Distributed Lumped-Element SIS Mixer with Very Wide Instantaneous Bandwidth."

TORRELLES, J.M.; PATEL, N.A.; ANGLADA, G.; GÓMEZ, J.F.; HO, P.T.P.; LARA, L.; ALBERDI, A.; CANTÓ, J.; CURIEL, S.; GARAY, G.; RODRÍGUEZ, L.F. "A Pair of Close YSOs with Strikingly Different Outflow Ejection Geometry."

Publications

TRINIDAD, M.A.; CURIEL, S.; MIGENES,V.; PATEL, N.; TORRELLES, J.M.; GÓMEZ, J.F.; RODRÍGUEZ, L.F.; HO, P.T.P.; CANTÓ, J. "Very Large Array Simultaneous 1.3 cm Continuum and H2O Maser Observations Toward IRAS 20126+4104."

TSUBOI, M.; INATANI, J.; KASUGA, T.; KODAIRA, S. "A Wide-Band Tuning Method for a 35-50 GHz SIS Receiver."

TURNER, B.E.; HEILES, C. "The C4H Zeeman Effect in TMC-1: Understanding Low-Mass Star Formation."

VAN DER TAK, F.F.S.; MENTEN, K.M. "Very Compact Radio Emission from High-Mass Protostars. II. Dust Disks and Ionized Accretion Flows."

VERSCHUUR, G.L. "If We Are Alone, What on Earth Are We Doing?"

VOSS, H.; BERTOLDI, F.; CARILLI, C.; OWEN, F.N.; LUTZ, D.; HOLDAWAY, M.; LEDLOW, M.; MENTEN, K.M. "Quasars in the MAMBO Blank Field Survey."

WANG, H.; LAI, R.; LO, D.C.W.; STREIT, D.C.; LIU, P.H.; DIA, R.M.; POSPIESZALSKI, M.W.; BERENZ, J. "A 140-GHz Monolithic Low Noise Amplifier."

WANG, H.; TAN, K.L.; TON, T.N.; DOW, G.S.; LIU, P.H.; STREIT, D.C.; BERENZ, J.; POSPIESZALSKI, M.W.; PAN, S.K. "A High Gain Low Noise 110 GHz Monolithic Two-Stage Amplifier."

WANG, H.; TON, T.N.; TAN, K.L.; GARSKE, D.; DOW, G.S.; BERENZ, J.; POSPIESZALSKI, M.W.; PAN, S.-K. "A D- Band Monolithic Low-Noise Amplifier."

WANG, H.; TON, T.N.; TAN, K.L.; GARSKE, D.; DOW, G.S.; BERENZ, J.; POSPIESZALSKI, M.W.; S.-K. PAN, S.-K. "110- 120 GHz Monolithic Low-Noise Amplifiers."

WANG, Y.P. "Modelling the Evolution of Dusty Starburst Galaxies in Multi-Band Deep Surveys."

WEINREB, S. "Low Noise Technology, 1982 State-of-the-Art."

WEINREB, S.; POSPIESZALSKI, M. "X-Band Noise Parameters of HEMT Devices at 300K and 12.5K."

WEINREB, S.; POSPIESZALSKI, M.W.; NORROD, R. "Cryogenic, HEMT, Low-Noise Receivers for 1.3 to 43 GHz Range."

WILLIAMS, D.R.; LUM, W.; WEINREB, S. "L-Band Cryogenically-Cooled GaAs FET Amplifier."

WILLSON, R.F. "Very Large Array and SOHO Observations of Type I Noise Storms, Large-Scale Loops and Magnetic Restructuring in the Corona."

Publications

WILSON, T.L.; BEASLEY, A.J.; WOOTTEN, H.A. "Status of the Atacama Large Millimeter Array."

WITHINGTON, S. "Scattered Noise Waves in Microwave and Millimetre-Wave Networks."

WITHINGTON, S.; YASSIN, G. "An Investigation of the Input Impedance of a Microstrip Probe in Waveguide."

WOLLACK, E.J.; POSPIESZALSKI, M.W. "Characteristics of Broadband InP Millimeter-Wave Amplifiers for Radiometry."

WOOTTEN, A. "ALMA: Exploring the Outer Limits of Radio Astronomy."

WOOTTEN, A. "The Atacama Millimeter Array (ALMA): Imaging Cosmic Dawn at Near-THz Frequencies."

WORRALL, D.M.; BIRKINSHAW, M. "X-ray Synchrotron Emission from the Oblique Shock in the Jet of the Powerful Radio Galaxy 3C 346."

WROBEL, J.M.; RECTOR, T.A.; TAYLOR, G.B.; MYERS, S.T.; FASSNACHT, C.D. "Active Galaxies at Milliarcsecond Resolution in the NOAO Deep Wide-Field Survey."

WU, J.; EVANS, N.J. II; GAO, Y.; SOLOMON, P.M.; SHIRLEY, Y.L.; VANDEN BOUT, P.A. "Connecting Dense Gas Tracers of Star Formation in our Galaxy to High-z Star Formation."

XU, Y.; REID, M.J.; ZHENG, X.W.; MENTEN, K.M. "The Distance to the Perseus Spiral Arm in the Milky Way."

YIN, Q.F.; HUANG, J.H.; ZHENG, W. "Radio Constraints on the Starburst Age of Two Wolf-Rayet Galaxies."

YORK, T.; JACKSON, N.; BROWNE, I.W.A.; WUCKNITZ, O.; SKELTON, J.E. "The Hubble Constant from the Gravitational Lens CLASS B0218+357 Using the Advanced Camera for Surveys."

ZAPATA, L.; RODRIGUEZ, L.F.; HO, P.T.P.; BEUTHER, H.; ZHANG, Q. "In Search of Circumstellar Disks Around Young Massive Stars."

ZHANG, J.S.; HENKEL, C.; KADLER, M.; GREENHILL, L.J.; NAGAR, N.; WILSON, A.S.; BRAATZ, J.A. "Extragalactic H2O Masers and X-ray Absorbing Column Densities."

ALMA Construction

The Joint ALMA Office (JAO) 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.

In fact, this particular report covers a six-month period from June through December 2005. This is because the JAO submitted a summary of the material provided to the Garmisch ALMA Cost Review in lieu of a Quarterly Report with the understanding that the next report would cover a six-month period.

Status of NRAO ALMA Program Plan Objectives

The 2006 NRAO Program Plan sets 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.

Management IPT Objectives:

- **Ensure that PMCS earned-value reporting is available by Q1 2006:** *On track for end of Q1 2006.*
- **Hold a successful Cost Review of the ALMA project in October 2005:** *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 early in the New Year to examine the cost implications of this. It also became clear that a North American Cost/Management Review would be required to review the NSF component of the ALMA budget and on a similar timescale to the Delta Review.*
- **Finalize the agreement between AUI and NINS/NAOJ by Summer 2006 (subject to NAOJ submittal of their final RFQ):** *Final RFQ from Japan may be as late as May 2006, in which case this may become late summer.*
- **Finalize the MOU between the NRAO and HIA by November 2005:** *Completed on schedule and delivered to HIA for signature.*
- **Support AUI in determining an acceptable method of employing local staff by Spring 2006:** *On track for a successful resolution in January 2006.*

Site IPT Objectives:

- **Complete construction of the AOS Technical Building by April 2007:** *The building construction completion is on track. The Foundation Package is completed and the Shell Package is scheduled to be completed by late March 2006.*
- **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:** *Not started; this will be done in first quarter 2006. This activity was deliberately delayed to allow an extended negotiation of the AOS TB completion package and to accelerate the Vertex site erection facility bid/award process.*
- **Complete procurement of AOS Technical Building outfitting material by March 2006:** *On track; bids have been solicited and are scheduled to be opened in March 2006.*
- **Complete ALMA–supplied site work at the Vertex site-erection facility by April 2006:** *On track; grading has been completed, and antenna foundations have been put out to bid and are in the evaluation and award process. Utilities installation scheduled for first quarter 2006.*

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 3 weeks from the original schedule date to accommodate the North American ALMA Cost/Management Review in January.*
- **Hold the Antenna Pre-Production Design Review in June 2006:** *This objective is running late due to: i) the Finite Element model development taking longer than predicted, ii) design of the transporter interface, and iii) a delay in getting the subcontract for the azimuth bearing in place. The specifications for the azimuth bearing, especially the 'wobble' specification 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 ~2 months late, although this is not yet formalized. However, procurement of long lead items such as the CFRP Backup structure, Invar support cone, and aluminum reflector panels is going forward.*

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 31 March 2006. The 2-month delay can be attributed to the Thermal Design Review of the Chassis and preparation of documentation for the CDR.*
- **Freeze the hardware design of the monitor and control circuit in February 2006:** *This activity is currently scheduled to complete on 12 June 2006. Although this delay appears to be ~ 4 months past due, a re-planning effort in late December 2005 shifted the target completion of this milestone out to early April 2006. The true 2-month delay is attributed to design delays for Cryostat M&C and procurement delays in the CPDS & IF modules.*
- **Make the NA Front End Integration Center operational in April 2006:** *This activity is on track, with the proviso that initial measurements will utilize harmonics mixers to lock the LO until the optical signal generator needed for simulating the ALMA LO reference is delivered in August.*

Back End IPT Objectives:

- **Complete the CDR on all BE equipment by October 2006:** *IFDC and LO Photonics CDRs may be rescheduled until after production units have been tested in PSI.*

- **Deliver pre-production racks to the ATF to support production receiver by August 2006:** *Production receiver scheduled for delivery in Feb 2007. In order to best use Back End resources, it is proposed to combine integration of pre-production racks bound to both Chile and the ATF. This is scheduled to be completed by end of calendar year.*
- **Deliver empty racks to the OSF for "form fit" test in antenna by Aug 2006:** *On track.*
- **Ship the LO reference to the OSF for the AIV (assembly, integration, and verification) single-antenna test by October 2006:** *On Schedule.*
- **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 will be dependant on the PSI schedule.*

Correlator IPT Objectives:

- **Prepare the first quadrant of the correlator for shipping in June 2006:** *This activity is on track. Once ready for shipping this 1st Quadrant will go into storage for a period of ~1 year until it can be received at the OSF. This, in turn, will allow space for 2nd Quadrant to be assembled and tested. It may be possible to delay for a few more months while part of the 3rd Quadrant assembly is done in the correlator lab.*
- **Ship test fixtures to Chile in June 2006:** *This activity is still on target – no delays anticipated at this time. However, unless there is a test lab either at the OSF or in Santiago, this shipment may be delayed without adverse effect—it is not really needed until the 1st Quadrant arrives in Chile.*
- **Complete assembly of the second correlator quadrant in June 2006:** *The 2nd Quadrant will have the station and correlator racks assembled and power rack reconfigured by 05 May 2006. This will be followed by installation of 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:** *Development started; completion expected as scheduled.*
- **Support first fringes at the ATF in June 2006:** *Development and testing in progress; completion will depend on successful completion of sufficient hardware and software testing in the lab. It would not be prudent to move to the ATF prematurely, since debugging is more difficult there. Meeting this date is possible but will be difficult.*
- **Hold an incremental CDR in June 2006:** *Completion expected as scheduled.*

ALMA Construction

Systems Engineering & Integration IPT Objectives:

- **Begin detailed planning of antenna AIV (assembly, integration, and verification) in Chile in January 2006:** *On track (this is a JAO Project Engineer deliverable).*
- **Install full electronic system and control software on ATF antennas in January 2006:** *Running approximately six months late owing to late delivery of hardware to PSI and difficulty in achieving reliable system connectivity and system stability. The relative phase of timing signals in LO and Data Transmission System modules is the leading problem that needs to be resolved.*
- **Obtain 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:** *On track (this is now a European deliverable).*

Science IPT Objectives:

- **Deliver the final long-baseline configuration in December 2005:** *A strawman long-baseline configuration design was delivered in July 2005. This design awaits reconciliation with the design for the road and fiber network on the site.*
- **Deliver all remaining baseline configurations in September 2006:** *On schedule.*

Atacama Large Millimeter Array

Quarterly Report for the period July-December 2005

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

Table of Contents

1 Management IPT

1.1 European Project Office

1.1.1 Overview

1.1.2 Personnel

Hans Rykaczewski took up his post as the ALMA European Project Manager and ALMA Division Head on July 1.

Viola Wang has been seconded from ALMA-Japan for three years to work in the Computing IPT at ESO in Garching. She arrived at ESO on July 1. Alessandro Caproni started to work in the Computing IPT on October 1, as Paid Associate supported by ALMA-J.

The Antenna Production Engineer, Pascal Lapeyre, took up his duties on September 1, 2005. Engineering support is still obtained from Volker Heinz, especially on interface issues between Antenna and Front End.

Hervé Kurlandczyk started on October 1 as Back End Integration and Data Communication Engineer.

Beatrice Sivertsen has started as Paid Associate in the ALMA Administrative Support on October 17.

Gareth Apinall was selected as the European ALMA Project Scheduler/Planner and he started on November 2.

Fabio Biancat Marchet has been appointed to become the IPT Deputy Leader for the Back End project in ALMA and accepted his nomination in October. As planned previously, Fabio takes over from Alain Baudry, who continues to serve as the IPT Deputy Project Leader for the Correlator. The European Project Management thanks Alain for his dedicated and excellent work for the ALMA Back End project. Alain has been involved in many important and crucial phases of the Back End project since the very beginning, about six years ago.

1.1.3 Contract Activities

After rebaselining of the ALMA project, ESO Council received updated information to decide on the affordability of ALMA. Documents were submitted, as scheduled, on September 8th. A Committee of Council meeting was held on September 16th in Garching, followed by a Committee of Council and Council meeting on September 29th and 30th in Brussels. Following approval by the ESO Finance Committee at their Extraordinary

Session on October 5th, 2005, on the selection of the supplier for 25 antennas, with an option to increase the total number to 32 antennas, preparations to sign the procurement contract with the AEM (Alcatel Alenia Space France, Alcatel Alenia Space Italy, European Industrial Engineering S.r.l., and MT Aerospace AG) Consortium was a prime activity. Meetings addressing technical, managerial, commercial and legal aspects were held. In parallel, the ALMA Director was requested to forward the proposal to place the procurement contract with the AEM Consortium to the ALMA Board for concurrence. The ALMA Board agreed to this proposal at its meeting on November 1st, 2005. The procurement contract was signed on December 6, 2005, at ESO in Garching. The completion of the provisional acceptance of the first antenna is scheduled for September 21, 2008. The provisional acceptance of the 25th antenna shall be completed by December 6th, 2011, i.e., exactly 72 months after contract signature. The kick-off meeting for this contract was held at the Alcatel Headquarters on December 19th and 20th. Besides the day-to-day interaction with the AEM Consortium, monthly technical progress meetings (face-to- face) are foreseen.

One of the special features of ALMA is the possibility to move the radio telescopes to well defined positions at the high Array Operations Site (AOS) on Chajnantor. In order to do this, specially designed transporters, meeting all hostile environmental conditions at an altitude of 5000 meters, need to be designed, manufactured and delivered to the Operations Support Facility (OSF) in the Atacama Desert. The Call for Tender for the two Antenna Transporters, issued on March 16, was closed on July 15. ESO has received fewer bids than expected. After approval by the Finance Committee on November 8th and 9th, 2005, a procurement contract with Scheuerle Fahrzeugfabrik GmbH for the supply of two antenna transporters was negotiated. The contract was signed on December 21, 2005. The kick-off meeting was scheduled for mid January 2006. The first transporter shall be delivered 18 months after contract signature.

At the ESO Finance Committee meeting on November 8 and 9, 2005, several other proposals for contracts have been presented:

- a proposal to place a contract with the University of Bordeaux for the manufacture, assembly and testing of tunable filter cards for the ALMA Correlator. This proposal was approved and the contract is in preparation.
- a proposal to extend the existing contract with COPEC for the supply of diesel petrol and gasoline for the ALMA OSF site, covering the first six months of the year 2006. This proposal was approved.
- a proposal to extend the safety engineering services with Arze Recine, covering the period from January 1, 2006 to December 31, 2007. This proposal was approved.

At the same Finance Committee meeting, the following announcements of forthcoming calls for tenders were made:

- concrete and associated works at creek and canyon crossings for the completion of the ALMA access road to the OSF and AOS.
- fabrication, assembly, and test of production Water Vapour Radiometers (WVR).
- procurement and installation of EU Front End Integration Center test sets.
- procurement, assembly, and test of production Front End chassis and power supplies.

Offers for the construction of the technical facilities at the OSF were opened on August 29, 2005. Due to budgetary constraints, these offers were not affordable. Therefore, a new call for tender, with a reduced, but recoverable, scope has been issued. The replies are due on February 2, 2006. It is expected to propose a supplier to the ESO Finance Committee at its Extraordinary Session, scheduled for March 2, 2006.

1.1.4 Technical and Managerial Concerns

Site

- The delay of the start of construction of the OSF Technical Facilities raises concerns regarding budget and schedule. The original tender documentation was completed in October 2004. The tendering period is closing early February 2006, and a proposal to ESO Finance Committee can be made only in the beginning of March 2006.

- In the course of rebaselining the ALMA project, the value of many work packages has changed. A decision on the value balance transfer of work packages from North American to Europe is pending and needs urgent attention as work is proceeding.

Antenna

- Two very important and critical procurement contracts, namely for the antennas to be supplied by ESO and the antenna transporters have recently been signed. The kickoff meetings of both projects were successfully held. At this stage of these projects, there are absolutely no reasons to expect any major deviations to the terms and conditions of the contracts. However, due to the importance of both contracts, close monitoring and control of schedule and cost is essential.

Front End

- First Band 9 Local Oscillator: A prototype WCA and x6 frequency multipliers were shown to give satisfactory performance over 80% of the Band 9 frequency range, and these components are in use for testing at SRON. Alternative power amplifier and frequency multiplier configurations are being designed and fabricated.

- Mechanical tolerance budget: Concerns remain about the mechanical tolerance budget and its effect on optical pointing, i.e., how well the cartridge beams are aimed at the subreflector and the effects of elevation angle. A meeting is scheduled for January 17-18 to discuss these issues.

- Indium Phosphide (InP) transistors: The risk related to the availability of InP transistors, to be used in cryogenic IF amplifiers, has been retired. Sufficient devices, 2000 pieces, for the production of all Band 7 and 9 LNAs were delivered by HRL to ESO in December 2005.

Back End

- The integration of the DTS components, supplied by Europe in the BE, although functionally successful, had shown some instabilities. A partial re-design may be required.

- A change in the multiplication ratio of some frequency multipliers within the FE could require a re-definition of the specifications of the photomixer blocks being manufactured at RAL. This could impact on cost and/or schedule.

- The output of the Fibre Working Group is on the critical path for completing the AOS Site layout in time for the issue of the Call for Tender for these works. The preliminary design of the AOS External Fibre System was completed. The completion of the design of the AOS Internal Fibre System is scheduled for the first Quarter 2006.

Correlator

- In order to meet the Correlator schedule, the mass production of the Tunable Filter Bank should be started by the University of Bordeaux within the first Quarter 2006. The design is currently undergoing final validation.

Manpower

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

1.2 North American Project Office

1.2.1 Overview

The period in review has been another very busy and productive period in North America with two pivotal events in the history of the ALMA Project; the signing of the NA Antenna contract and the completion of the rebaselining exercise.

The Antenna contract was signed with Vertex Communications Corporation on 11 July at AUI's corporate headquarters in Washington. The contract (for $183M) is for 25 antennas with options to purchase up to 32. This represents the culmination of many years of hard work through the prototypes and subsequent evaluations and is a major milestone for the project.

The period in review has been dominated by the rebaselining exercise and the subsequent reviews. Through the summer the rebaselined budget was completed and scrubbed. The final package was presented to the ALMA Board by the JAO on 8 September. The subsequent ALMA Cost Review of the rebaselined project was held in Garmisch Partenkirchen on the 13-15 October. The review was an international review Chaired by Steve Beckwith and co-chaired by Thijs de Graauw. 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. It also became clear that a North American Cost/Management Review would be required to review the NSF component of the ALMA budget and on a similar timescale to the Delta Review.

At its November Board meeting, the ALMA Board agreed on a number of the BCPs that had been proposed in Garmisch. Subsequently, these were entered into the project budget.

An exercise led by the JAO was initiated in late November to review the Value Balance on the ALMA project; a prerequisite to determining the split of the overall ALMA budget between North America and ESO.

During the period in review, a high level delegation from NSF/NRAO/AUI visited Taiwan to discuss the prospect of Taiwan joining the North American ALMA partnership.

1.2.2 Personnel

Jeff Zivick took up the post of NA Antenna IPT lead in July 2005. Prior to this Jeff had been part of the Systems Engineering Team on ALMA.

1.2.3 Contract Activities

During this period, the following significant orders/contracts were placed:

1. The NA production antenna contract for 25 antennas was placed with VertexRSI on 11 July 11 2005 for $183,000,000. This is the ceiling price in an indexed contract; the final contract cost ultimately may be as low as $169,000,000. The contract is written for phased releases; the initial release at the contract signing was for $50,000,000.
2. An order for the near-field measurement system was placed with Nearfield Systems, Inc. on August 8, 2005, in the amount of $206,610.

3. On August 2, 2005, an order was placed with Automated Industrial Technologies in the amount of $218,300 for the front end tilt table system and cartridge loading system.
4. Aeroflex Test Solutions received an order on July 14, 2005, in the amount of $151,500 for the phase noise test system synthesizer module, the 1.7–18 GHz downconverter, the low noise RF reference synthesizer module, and the dual RF 26.5 GHz controller.
5. A contract was placed with PPARC on July 28, 2005, in the amount of $100,000 for an LO Reference Back-up Study.
6. Phase 3 of the Project Management Control System was awarded to Triad Project Management Services, Inc. on December 19, 2005, in the amount of $524,000. This is a phased agreement which ultimately will authorize $1.2 million to Triad through December 2011.
7. The contracts for the AOS Technical Building Foundation and Shell Packages were signed on August 1, 2005, with the company Con-Pax, for ~$532,177 and $1,207,383, respectively. The foundation package work is finished satisfactorily and the shell package work is still under way
8. The Security Services for the ALMA Site were hired for the period of September 2005-August 2007: ~$220,000.
9. The contract for the ALMA Contractors' Camp Finishes was signed on September 12, 2005, for ~$374,074. This work is finished satisfactorily.
10. The invitation for bid process for the "Catering and Cleaning Services for the ALMA Sites" was finished and submitted to NSF. This contract is expected at ~$2,998,369 for the March 2006-December 2007 period.
11. The contract for the Vertex Site Grading was awarded to Asercop for ~$180,000.

The orders cited above which were placed in Chile were written in Chilean pesos. For this report, pesos are converted to the approximate amount of US dollars (hence, the "~").

The Completion Package for the AOS Technical Building was bid and bids were received in December. The evaluation process is underway. An Invitation for Bid for the Antenna Pads for the Vertex OSF facility was sent out in December.

1.2.4 Technical & Managerial Concerns

The biggest Managerial concern for North America remains agreeing the scope of the project and securing the necessary resources to complete it. Completing the Value Balancing exercise is a critical part of this process.

Resolving the issue of who hires the local labor in Chile is now crucial and was flagged up as a high risk by the Garmisch Cost Review.

In terms of technical concerns, the Photonic LO which is a high risk item has reduced in risk as the system is maturing. Band 9 LO power remains a concern but the team is confident that the problems can be overcome.

The successful start of Prototype Systems Integration in Socorro is a major milestone which will help both identify technical problems and retire risk.

2 Site IPT

2.1 Status

2.1.1 Antenna Stations (foundations) at the AOS

The antenna stations (foundations) design prepared by M3 based on the approved antenna station ICD exceeds the original foundations budget substantially.

An alternative foundation design based on the same ICD documentation has been elaborated by EIE and has been presented at the IPT meeting in Charlottesville on 2004-Oct-02 for analysis by the North American Executive. A consensus between the two Executives as of how to proceed with the implementation has been reached. Both designs were submitted for budget estimates prepared by local Chilean firms. These budget estimates have been completed successfully. Standard basic design included in the re/baselining estimate is the EIE design. Design modifications will need to be implemented at areas of lower rock elevations, where the EIE design cannot be used.

2.1.2 Technical Building at the AOS

Construction of the AOS Technical Building Foundation and Shell Packages started on 20-Sep-2005 and shall complete by mid March 2006.

At present, the foundations are approximately 60% complete. The steel structure is being fabricated, 50% of the material is on site and erection is scheduled to start in January 2006.

The concrete and steel panels for the building's walls and roofing are contracted and on its way to be delivered to the site.

The tender documentation for the construction of the Completion Package was released and bids were received on 16-Dec-2005. The incoming bids are being analyzed at present. Work should begin in mid March 2006. Completion is scheduled to be in April 2007.

2.1.3 Permanent Access Road

Road maintenance operations continued during the reporting period. As of to date approximately 37 km of modified road formation level has been constructed. This represents approximately 85% of the total length of the road of 43 km. The road pavement or finishing will be contracted at a later date (2007-2008).

AOS TB construction general view

Steel structure on site

Finished foundation and soil compaction;

Concrete pouring

Borrow pit next to road at Km 36, at 4.700m; Borrow pit next to road at Km 36, at 4.700m

Closing the canyon at Km 37, at 4.800m; Safety measures at areas with heavy machinery

Road completed to final width;

Final road layout

2.1.4 ALMA and Contractors Camps at the OSF

The Contractors Camp interior finishes and external work to reach a 180 bed capacity has been substantially completed. The hand-over from contractor was in late December 2005.

Contractors Camp finishes;

Contractors Camp external works

Contractors camp dining room

The ALMA Camp is operating with a 30 bed capacity since August 2005. An agreement regarding cost sharing between NA and EU for the running of the camps and associated safety, security and other services has been reached.


ALMA Camp;


ALMA Camp dormitorios;


ALMA Camp dormitory

2.1.5 Technical Facilities at the OSF

The tender documentation for the construction of the Technical Facilities at the OSF was released for re-bidding on 09-Dec-2005. Closing date is scheduled for 02-Feb-2006. The incoming bids will then be analyzed and the contract proposal will be presented to the extraordinary Finance Committee meeting in March 2006. Contracting could thus start in April 2006 and Provisional Acceptance is scheduled to be in fourth quarter of 2007. Mass excavation works were completed in September 2005.

Earthworks completed at OSF

2.1.6 ALMA Project Power Supply

The contract for the design of the Power Generation and Transmission Systems and elaboration of an update of the feasibility study of Fichtner has been awarded to Lahmeyer International, Germany. The update was considered to be advisable due to the changed situation in Chile with respect to natural gas supply and the recent fuel price increases. The new feasibility study is scheduled to be received on 20-Jan-2006. The design of the Power Generation and Transmission Systems is to follow and estimated to be completed in December 2006.

2.1.7 Construction site Safety Services

The service contract for a site safety engineer has been prolonged until the end of 2006. The permanent safety engineer has started his work on Site in September 2005.

2.1.8 Environmental Aspects

In October/ November 2005 a survey of vizcacha colonies was made at areas above km 30. Some movements within the colonies were reported by the consultants. A new survey is scheduled in the second quarter of 2006. The remains of a small local settlement located at km 21 have been re-built under the advice of the last owner and the consultancy of an archaeologist from San Pedro. The place serves now as museum and interpretive center for local cultures and history.

Museum with ancient Fox trap (front left); Information board and Museum (back)

Museum / ancient farm (bird view); Farm houses and animal fence; Vizcacha

2.1.9 Configuration Review

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

2.1.10 Budget

The budget of the Site IPT was re-estimated. The re-estimating (re-base lining) process took place between January 2005 and was substantially completed by May 2005. The re-base lining budget was reviewed and confirmed by the review panel during the ALMA Cost Review meetings in Garmisch-Partenkirchen, Germany in October 2005.

2.1.11 ALMA OSF to AOS fiber optic link

During this reporting period two (2) Chilean consultants were requested to submit a budget estimate for the design of the OSF to AOS fiber optic link. Basic estimates were received and will be finalised including estimates for the construction of the line after receiving the applicable design of the support structure (overhead power lines) from Lahmeyer International.

2.1.12 Antenna Contractor lay down areas

The lay down areas for the European, North American and Japanese antenna contractors have been defined. The tender documentation for the grading of the Vertex Antenna lay down area was released and bids were received on 05-Dec-2005. Grading works are scheduled to start at beginning of January 2006 and be finished by mid February 2006 for Vertex and by the end of March 2006 for the ACA. The design of the Alcatel lay down area is expected to be received during Q1 2006.

2.1.13 ALMA Camps catering and cleaning services

Catering and Cleaning Services for the extended ALMA and contractor's camp have been tendered. Contract was awarded mid December 2005. Services started on 02-Jan-2006.

2.1.14 Culverts and Drainage Structures as part of the permanent access road

Construction start of the culvert system at km 7 will be in January 2006. Duration of this work is 90 days. With the completion of this structure the road between the intersection of the Chilean Road CH 23 and the OSF will be transitable without deviation.

The remaining drainage structures are being tendered and/or being constructed in accordance with the design documentation by individual subcontractors under direct ALMA supervision.

2.2 Concerns & High Level Risks

- Resolution/ Consensus of joint camps running and construction costs
- Budget availability due to the re-bidding of the OSF and subsequent late construction start.

- Fiber Optics design by BE and Computer group.
- Natural gas availability for the Permanent Power Supply.
- Changed antenna station layout

2.3 Next Period Goals

- Complete tender actions and start construction for the culvert and drainage structures as part of the permanent access road.
- Complete construction of the modified formation level of the access road all the way to the AOS until March 2006.
- Complete construction work for the foundations, structural steel and shell of the AOS Technical Building.
- Start construction of the AOS Technical Building Completion Package.

Design and preparation of the tender and construction documentation for the power generation and transmission system.

Complete Tender action and start construction of the OSF Technical Facilities.

Complete Tender action for the construction of the road intersection with Chilean road CH23.

Prepare tender documents for AOS high site road and utilities design and start this design effort.

Grade the Antenna Contractors lay down areas and start building the antenna foundations within those areas.

3 Antenna IPT

3.1 Status

3.1.1 Production Antenna Procurement

3.1.1.1 NA Antennas

- Following the agreement from the National Science Foundation to the proposal of AUI to enter in negotiations and pass a contract to VertexRSI, AUI on July 12th 2005 awarded a contract for the delivery of up to 25 antennas with options to buy up to 7 more.

- The Kick-off meeting was held on 28, 29 July 2005. Since then the Contract is running normal with the pre-production design phase in which the complete baseline design of the prototype is checked and updated to make it fully respondent to the new specification set. Minor change requests, not related to science specification, were asked by VertexRSI and by ALMA and agreed to.

- The Preliminary Pre-Production Design Review will be held February, 2006 at Vertex Antennentechnik premises. Contractual Pre-Production Design Review is scheduled late spring/summer.

Delivery of the first antenna on site is foreseen for 1st quarter 2007, 6th antenna in August 2008, 25th antenna in November 2011. The prices are subject to revision with ceiling. No penalty clauses are included in the contract.

3.1.1.2 European Antennas

- Despite the agreement of the ESO Finance Committee in June 2005 to award a contract to Vertex Antennentechnik, the procurement was stalled at ESO. The ESO Finance Committee requested assurance on the affordability of ALMA for ESO by the ESO Council within the revised scope of the rebaselined project.

- Given the impossibility to sign a contract prior to the expiration of the validity of the offers in June 2005, ESO asked the two valid bidders (Vertex Antennentechnik and the Alcatel Alenia Space, European Industrial Engineering, MT Aerospace Consortium) to extend the validity until October 31, 2005.

- In September the rebaselining process was completed and the results were presented to the ESO Council. The documents were carefully reviewed during September. The ESO Committee of Council and the ESO Council held meetings and concluded with a resolution stating that:

- "(Council) reaffirms its commitment to proceed with ALMA …,
- decides that the estimated increase … in the cost to completion of the ESO share of the bilateral ALMA project is affordable and compatible with ESO's strategic priorities, …,

- requests the (ESO) Finance Committee to proceed to decide on the proposal to award a contract for the production of the ESO ALMA antennas."

- In September both Vertex and the AEM Consortium (in the mean time *Alcatel Space* and *Alenia* had completed their fusion to create *Alcatel Alenia Space*) confirmed the extension of their offers, but also revised the prices originally quoted in April 2005. The offer of AEM became significantly cheaper than the Vertex one. ESO therefore in accordance with its financial rules had to propose to the ESO Finance Committee to award the serial production Contract to the AEM Consortium. At their extraordinary meeting of October 5, the ESO Finance Committee approved the proposal to award of the Contract to the AEM Consortium.

- From October 16 to 19, 2005, the rebaselined ALMA Project was reviewed by an international, independent ALMA Cost Review Panel, appointed through the ALMA Board. At this review ALMA informed the Review Panel that ESO had to decide to award the antenna procurement contract to a different supplier than AUI did. It should be mentioned here that the cost estimate forwarded to the Cost Review Panel assumed that only one supplier be selected for the supply of all 50 ALMA-B antennas. Subsequently, it was decided to hold a Delta ALMA Cost Review to investigate the impacts of having two different antenna suppliers.

- On November 1, 2005 the ALMA Board approved the proposal of the ALMA Director to award the contract for the European share of the antennas to the AEM Consortium.

- During October and November ESO had extensive interactions and meetings with AEM to define the terms and conditions of the contract. Extensive discussions were dedicated to the lessons learnt form the prototyping activity and improvements for the serial antennas have been identified. The Technical Specification and the Statement of Work were updated to take into account changes occurred in the project since the original call for tenders and Change Requests requested in the meantime by VertexRSI.

- On December 6, 2005, ESO and AEM signed the contract for the delivery of 25 antennas (with options to procure more antennas, up to a maximum of 32). Provision Acceptance of the first antenna on site is foreseen for September 2008, the 25th antenna is scheduled for December 2011.

- The contract foresees a Pre-Production Design Phase of approximately 12 months duration with a final design review approval process by ESO.

- In accordance with ESO Procurement Rules and Procedures, the price define in the contract is a firm fix price, not subject to revision. The option for additional antennas can be exercised by ESO not later than June 2009. Penalty clauses are included in the contract.

- The Kick-Off meeting was held at the Alcatel Headquarters in Paris on December 19 and 20. The first Progress Meeting is scheduled for the beginning of February. Work has started, with system studies ongoing and preparation of internal ICD's.

3.1.2 Vertex Prototype Antenna

- The Vertex antenna is operating nominally at the ATF site. It is being used extensively for Prototype System Integration. Amongst others, we mention here the tests on the LO fibre cable wrap, as well as the activities linked to ALMA Software.

- A programmed maintenance cycle was done on the antenna. In addition, the antenna was used by VertexRSI to test certain aspects of the metrology system, not fully commissioned during the AEG and JATG work.

3.1.3 AEC Prototype Antenna

- The antenna was not used after the JATG tests in spring 2005. It has been put at disposal of Prototype System Integration. ESO performed an intervention in December for maintenance of the antenna and for supporting computing in the porting of the ABM software for the antenna mount. An intervention from the AEC consortium is planned in the framework of warranty (HVAC malfunction, receiver installation crane). In addition, the AEC antenna will be used by the AEM consortium for testing the metrology subsystem, similarly to what has been done by Vertex on the other prototype.

3.1.4 Antenna Transporter

- The Call for Tender for the design, manufacturing, transport and assembly on site of two antenna transporters issued in March 2005 was closed mid July. Only one bid was received, from one of the two companies originally involved in the feasibility studies performed by ESO in 2004, namely Scheuerle Fahrzeugfabrik GmbH. Other potential bidders were either not having free capacity or had been acquired by Scheuerle recently. A first technical evaluation of the bid was done in July and questions were raised to the bidder. Furthermore, meetings were held with the bidder to clarify technical issues and resolve reservations raised by the bidder. The process was completed in October and a final evaluation report

issued with positive recommendations related to the validity of the concept proposed and to the compliance with the statement of work and the specification.

- The ESO Finance Committee, at their meeting of November, approved the proposal by the ESO Management to award a contract for two transporters to Scheuerle Fahrzeugfabrik GmbH.

- At the request of the ALMA Project Manager, a review of the overall contractual documents (Specification, ICD's, Statement of Work) and of the proposal of Scheuerle was performed mid of December with participants from ESO, ALMA, NRAO, NAOJ, and external experts. Positive recommendations for proceeding with the present specification set and with the design proposed by the bidder were stated by the review panel.

- On December 22, 2005, ESO signed the contract for two antenna transporters with Scheuerle Fahrzeugfabrik GmbH. Penalty clauses for late delivery apply. The delivery of the first transporter at the OSF is planned for July 2007. The second is planned for January 2008.

- The contract foresees a design phase (Preliminary Design and Final Design) terminating with the Final Design Review. A factory testing phase is foreseen before shipping. Extensive testing at the OSF and the AOS is defined in the Statement of Work for acceptance. The vehicle will have a mass of approximately 150 tons and the dimensions about 10m x 15m x 6m (W x L x H).

3.1.5 Nutator and Optical Pointing Telescope

- The Nutator Technical Specification was scrutinized by the Science IPT to ensure the scientific objectives of ALMA would be satisfied by the production Nutator. The results of the Science review were used to revise the preliminary Nutator Technical Specification which was then distributed to a wider review audience within ALMA. The results of this second review cycle are being incorporated into a second revision which will be submitted to the CCB for final approval in late January, 2006. In parallel, the Statement of Work is being finalized and will be submitted for review late January, 2006.

- Development of the Technical Specification for the Optical Pointing Telescope (OPT) will be initiated in February, 2006, with release to industry for formal proposals planned for early April, 2006.

3.1.6 Rebaselining

A major advancement was achieved in the rebaselining process with the establishment of the AIPT SOW, the generation of updated Work Breakdown Structure, their associated cost sheets and the Risk Register. All data were presented at the ALMA Cost Review in Garmisch, Germany from October 16 to 19, 2005.

3.1.7 Antenna Stations Foundation

The Antenna IPT is active in the final definition of the procedures and tools for the alignment of the antenna stations. Prototyping of the I/F parts to the antenna and preparation of a test setup is ongoing.

3.1.8 Others

AIPT members took an active role in the CDR Review of the ALMA-J antennas to be supplied by Mitusbishi. This review was held in November 2005.

3.2 Technical and Managerial Risks and Concerns

- The de-phasing between the two Executives in passing their contracts and the fact that two companies are supplying ALMA-B antennas are additional complexities in the follow up of the design phase by the Antenna IPT and in maintaining the two specification sets. During the first months of the execution of the Vertex Contract no access to the Vertex documents was requested by ESO, as their procurement process was not concluded.

3.3 Tasks Scheduled For The Next Quarter

3.3.1 Production Antenna and Related Procurements

- Ensure the proper and efficient start of the AEM contract.
- Hold the Preliminary Pre-Production Design review for the VertexRSI antenna.
- Release of Nutator Specification and Statement of Work to industry for formal technical and cost proposals.
- Complete development of specification and statement of work for OPT device.
- Continue the support of the PSI activities at the ATF site, as needed.
- Prepare and manage the interface for the preparation of the two Contractor Work Areas with the site IPT.
- Refine the procedure of alignment of the antenna stations/antenna interface.
- Ensure the proper start of the Transporter Contract.

3.4 Progress on Milestones Defined in the Last Reporting Period

3.035.8565: Sign Contract for North American Antennas (up to 31+1)
Completed on July 11, 2005

3.035.8575: Sign Contract for Europe Antennas (up to 32)
Completed on December 6, 2005

Sign Contract for two Antenna Transporters
Completed on December 22, 2005

4 Front End IPT

4.1 Planned versus Actual Achievements

4.1.1 Integrated Product Schedule / Project re-baselining

The details of the FE IPT schedule are complete and available in the IPS. Most activity is now consisting of updating the status of the work elements on a regular, bi-weekly, basis. This activity is supported by the FE IPT schedulers at ESO and NRAO. Donald Tait, the scheduler responsible for the FE IPT at ESO has moved to a new position in the ALMA Project. He has been replaced by a new hire, Gareth Aspinall, who started in his new position on 2nd November 2005.

FE IPT management spent a substantial amount of time in preparing for the project wide cost review. A major part of this preparation consisted of updating the FE IPT budget with the most current cost estimates and implementing the impact of the changed project requirements. The updated FE IPT baseline plan for a 50-antenna array was presented at the cost review in Garmisch in October 2005.

At the end of the reporting period preparations started for the Delta Cost Review that is scheduled for January 2006.

The EU FE IPT manager attended the ACA 12-meter Antenna (8-9 Nov. 2005) CDR and the ACA Systems PDR (10-11 Nov. 2005), both held in Japan. After those reviews he met with ALMA-J FE IPT staff to discuss the follow up on the Band 4 and 8 PDRs, ACA Front Ends, ALMA-J RfQ and schedule of ALMA-B and J FE IPT activities.

4.1.2 Reviews

The ALMA-B FE IPT succeeded in finalizing all documentation for the Front End sub-system Delta Preliminary Design Review. The review meeting was held on 6th and 7th July 2005 at ESO in Garching. The review panel, consisting of both internal project members as well as external receivers experts, concluded that the FE design passed the PDR level and was even well beyond this point.

The IPT leaders and FE sub-system engineers participated in the System Requirements Review held at NRAO / Charlottesville in July 2005.

A review of the ALMA amplitude calibration device, jointly organized by the FE and Science IPTs was held on 25th August 2005 at IRAM in Grenoble/France. At this meeting various concepts and their expected performance (multi load according to ALMA Memo 461, dual load and semi-transparent vane) were presented and compared with each other to find the most suitable solution for ALMA. The recommendation from the review panel was to continue with the detailed development of a relatively simple two-load calibration device.

4.1.3 FE sub-system engineering

FE sub-system engineers provided support to various ongoing activities, including:

- Extensive preparations for Delta PDR in July 2005
- Front End integration and verification
- Cartridge acceptance test plans and procedures
- An update of the ICD between Antenna and FE in close collaboration with the Antenna IPT.

4.1.4 Cryostat

Assembly and verification of cryostat #2 was completed, followed by a successful PAI at RAL. After agreement with NRAO, the unit wasn't shipped directly to the NA FE Integration Centre since it might be needed for a design verification of the Band 6 optics at IRAM in Grenoble. Cryostat #2 was finally shipped by RAL and received at the NTC in December.

Assembly of cryostats #3 and #4 was completed this reporting period. PAI for cryostats #3 and #4 was done in the week just before Christmas.

Assembly of cryostat #5 is making good progress.

New versions of the Cryostat Statement of Work and Technical Specifications documents have been prepared and will shortly be circulated for review and approval.

Several cartridge bodies have been delivered to the Band 3, 6 and 7 cartridge groups giving them sufficient stock to complete cartridge pre-production.

Final plate drawings for the Band 9 cartridge were received from NOVA and are currently under production.

4.1.5 Optics

Band 6 optics testing at IRAM using a prototype delivered by NRAO was completed. Test results show that the optics works well and as required, having side lobe levels of not more then about 30 dB below the main peak. Problems with too high side lobe level as reported by NRAO were not encountered and the discrepancies between the two sets of measurements have not yet been resolved.

A new batch of Band 3 windows has been moulded.

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

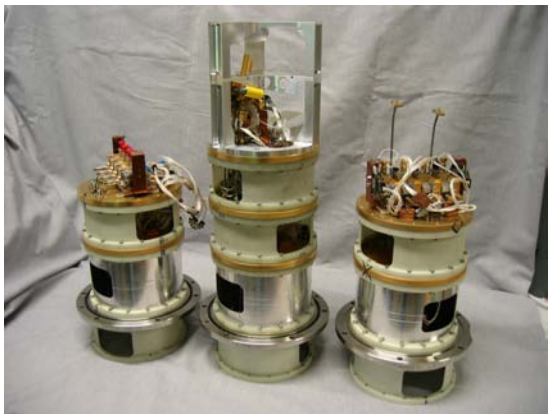
4.1.6 Cartridges

Band 3: Extensive testing was carried out on Cartridges #1 and #2. A plan was agreed for beam pattern measurement, and the equipment order was generated. The performance of the mixers in Cartridge #2 was demonstrated to meet the ALMA specification. The first official delivery will be Cartridge #2.

Band 6: Extensive testing and beam pattern measurement were conducted on Cartridges #1 and #2 in Cryostat #1. Most performance specifications were shown to be satisfied, although there remains a discrepancy between the beam patterns measured in the Cartridge Test System and in Cryostat #1 by NRAO and those measured at IRAM using the prototype cartridge. The design of the overmoded LO waveguide was modified to increase the amount of LO power available at the very low end of the band. The first official delivery will be Cartridge #3.

Band 7: Testing of Band 7 cartridge #1 has been completed. Acceptance test plan and procedures, required for formal acceptance by the NA FEIC, have been prepared and are currently in the approval process. Test results for cartridge #1 are being documented in preparation for the Preliminary Acceptance In-house. The PAI of cartridge #1 is scheduled for early February 2006. The NA FEIC and the ALMA Project Engineer have been informed of this schedule and invited to attend the PAI.

Mixer assembly production progresses well, units for cartridge #4 are being assembled and tested. Assembly of cartridges #2 and #3 continued and #4 has recently started.



Completed Band 7 cartridge #1 accompanied by partially assembled units #2 and #3.

Band 9: A pair of wideband, 4-12 GHz, cryo LNAs has been delivered to NOVA by Yebes Observatory in Spain. These amplifiers will be mounted in the first pre-production cartridge instead of the 4-8 GHz amplifiers used so far for cartridge verification.

The Band 9 Cartridge team focused on testing cartridge #1; unfortunately, this activity was impacted by technical problems the 1st LO, including failure of one of the cold

multipliers. In parallel and jointly with FE IPT sub-system engineers the cartridge acceptance plan has been developed based on the one prepared for the Band 7 Cartridge.

On 17th November 2005 a visit to Pamtech was made by the Band 9 cartridge management and the EU FE IPT manager to assess their capability of producing 4-12 GHz isolators as required. After this visit there is careful optimism that Pamtech can deliver these isolators but there is still concern because of repeatability of the design and the financial stability of the company.

A face-to-face progress meeting with the Band 9 Cartridge team was held on 1st Dec 2005. Current schedule is to complete pre-production cartridge #1 and deliver it to the NA FEIC by March 2006.

Preparations for a contract amendment are underway; a final proposal to be submitted to the ESO Management and the ESO Finance Committee shall be available by mid January 2006.

4.1.7 Local Oscillators

The Front End LOs (Warm Cartridge Assemblies and frequency multipliers) were delivered and tested with good results for Bands 3, 6, and 7. The prototype Band 9 LO with x6 multiplication factor continued to be a problem, with good noise performance confirmed, but the power provided is insufficient over 20% of the required tuning range. Extensive work, including development of alternative multiplier configurations using x9 and x10 multiplication factors, was done with the objective of increasing the power. MMIC power amplifier chips using GaAs technology instead of InP technology were ordered to obtain higher drive power, and Virginia Diodes Inc. was funded to develop the alternative frequency multipliers. A decision on the final configuration, after testing of the alternatives, is expected in mid 2006.

4.1.8 Front End Integration and Test

The European ALMA Front End Integration Centre will be located at Rutherford Appleton Laboratory near Didcot in the United Kingdom. Preparations to the building infrastructure to accommodate this FEIC have begun.

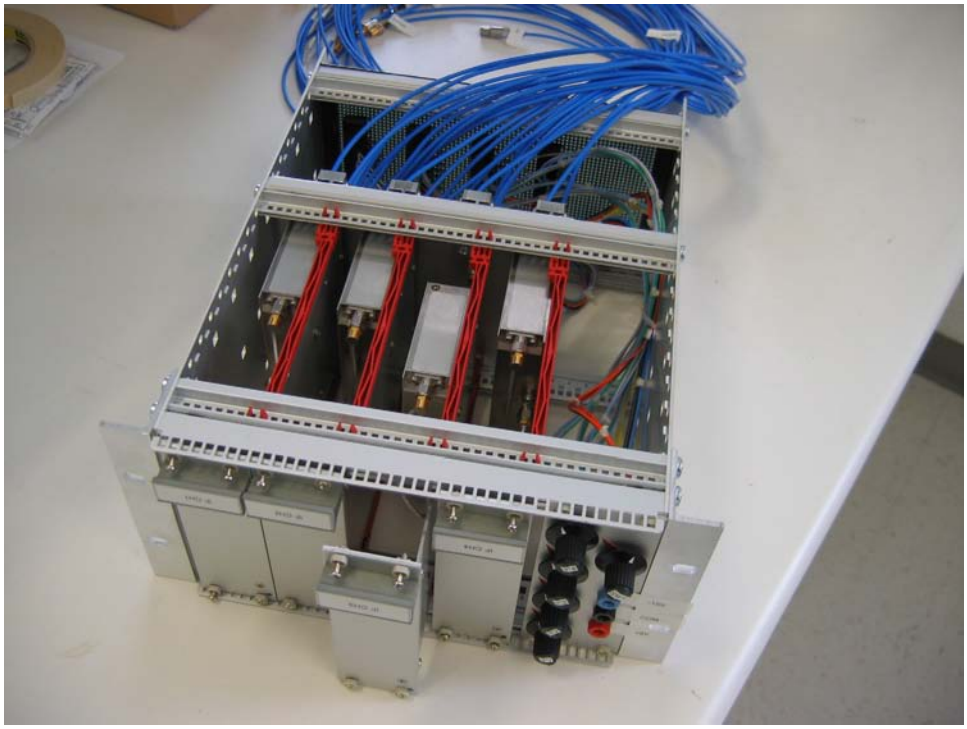
Further work on the Finite Element Model analysis of the Front End Support Structure (FESS) was performed, assuming a rigid antenna and with realistic modelling of the Front End itself (cryostat and electronics). The performance of various potential FESS materials was calculated, and a meeting was scheduled for 17-18 January 2006 to review the work and decide on the FESS material. A prototype for integration laboratory use made of steel was ordered.

The software for operation of Front Ends in both the Integration Centers and the antennas made good progress. It was agreed with the Computing IPT that certain parts of the code written for the FEIC will be incorporated into the operational software, easing the overall integration process.

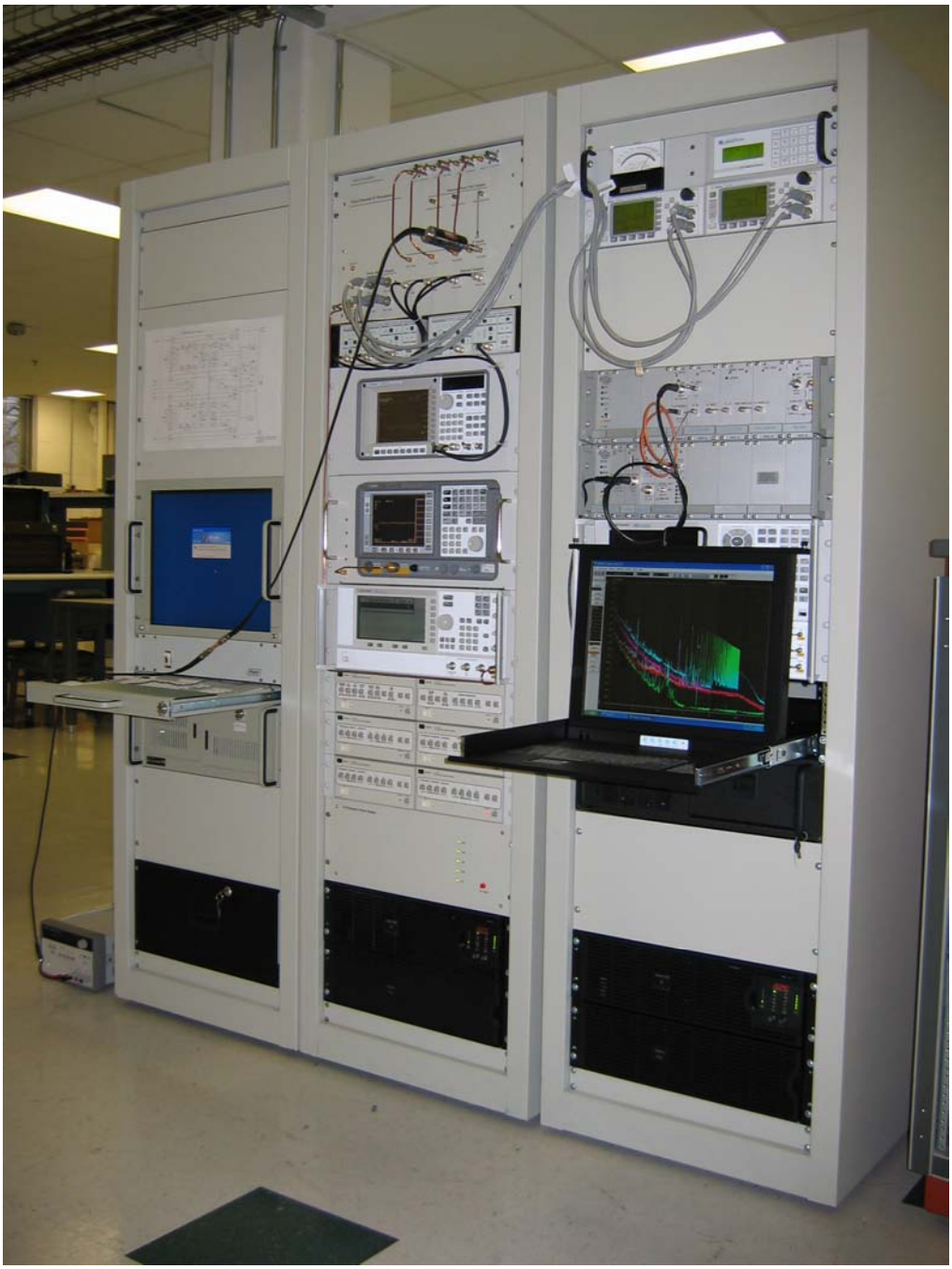
Significant progress was made in designing, fabricating, and delivering the support electronics, including DC Bias, Monitor and Control, IF Switch, and Power Supply and Distribution. Production of the DC Bias was assigned to NRAO Green Bank. The size and shape of the Power Supply remained undetermined, pending further information on antenna cabin space.

The IF Processor for the Test and Measurement System was completed and testing began. The orders for special handling equipment (Tilt Table and Cartridge Loader) and Beam Scanner were placed, with deliveries scheduled for early 2006.

Regular coordination videoconferences including personnel from both Integration Centers were begun.



The prototype IF switch housed in a subrack. It consists of four 10:1 switch assemblies and fits into the chassis below the cryostat.

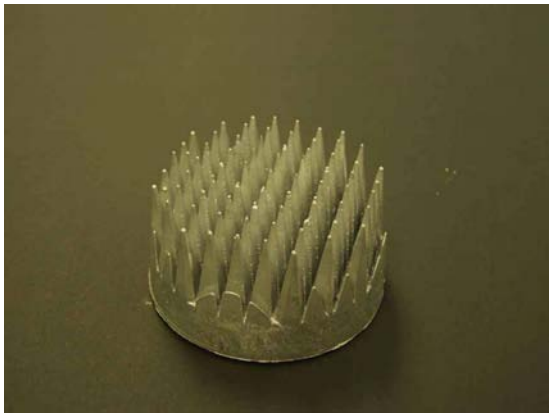


The Front End Test and Measurement System (FETMS) housed in three racks at the NA FEIC. The four-input custom IF Processor is at the top of the middle rack, and test signals are displayed on the Phase Measurement System in the right-hand rack. Most of the instrumentation consists of commercial off-the-shelf equipment, and much of the software is custom and shared with the operational software.

4.1.9 Amplitude Calibration Device

A review of the amplitude calibration device was held on 25th August at IRAM in Grenoble. The review was a joint activity of the Science IPT and FE IPT, chaired by Jeff Mangum. The final review report has been prepared and distributed. The recommendation from the review panel is to select a dual load device, with one load at room temperature and a second load at an elevated temperature of about 350 – 370 K, as the option for further detailed design and production.

After the review, the amplitude calibration device focus has been to develop a cost effective method to produce the hot loads. Using aluminium casting seems to be an interesting solution, but the RF performance has to be evaluated. For this purpose prototype Al castings have been produced.



Protoype Al Casting

Detail pyramid tips prototype Al casting

4.1.10 Water Vapour Radiometer

The two prototype WVRs have been installed on the SMA antennas on Mauna Kea/Hawaii. The optical interface between these WVRs and the SMA has been designed and manufactured. This relay optics will be mounted on the SMA antennas at the start of the next reporting period.

4.2 Technical status / performance achieved

There has been good progress in achieving the performance specifications for the cold cartridges, although some parameters remain to be verified. The FE local oscillators are in good shape except for the power problem with Band 9. The cryostats work exceptionally well. Pre-production versions of most of the support electronics are in regular use, and the remainder are in fabrication; this work is straightforward and poses no technical problems. There are only a few outstanding design issues to be resolved.

4.3 Planned activities for next period

Delivery of the first pre-production cartridges to the North American Integration Center is expected in the next quarter.

Assembly of the first Front End including cryostat, chassis, and support electronics will be mostly completed and initial testing will begin.

Building infrastructure for the European FE Integration Centre will be completed.

The test electronics for the North American FEIC will be completed.

We will continue with production of pre-production cryostats and cartridge bodies. Cartridge bodies will be based on a modified design further optimized for production.

Testing of the prototype WVRs at the SMA on Mauna Kea/Hawaii will be completed.

5 BACK END IPT

5.1 Planned versus actual accomplishments over the period

- Major procurements for pre-production modules are complete, to include preparation of SoW and specification; eg. the antenna racks and the IF processor.

- Completed testing of the 1st IF Processor prototypes including the re-designed Total Power digitizer.

- Phase noise tests of prototype modules completed for prototype SI.

- Completed e2e LO analysis; final documentation to be in SE & I IPT System Technical Requirements Review report.

- Photonics LO photomixers being assembled at RAL. Delivery shifted from Dec 05 to Jan 06 due to delay in procurement of u^2t photodiodes and accommodation of special fibre pig tail.

- Delivered two line length corrector LRU (line replaceable units) and one laser synthesizer to prototype SI for testing. Completed 1st prototype for Fiber Optic cable antenna wrap (2 units).

- Completed testing of new designs for LO Reference Receiver, Central Reference Generator and Distributor, though problems with phase sensitivity in the reception of the Timing Event and 125 MHz reference were uncovered, which may lead to further re-design work.

- UKC (University of Kent, Canterbury) completed the LPR optical amplifier report and Photonic Distribution report, and performed studies on PMD-related problems with fiber optic phase performance.

- Three possible suppliers have been contacted for the Master Frequency Standard; negotiations ongoing.

- Completed construction of test area for Central LO in Charlottesville. Area includes raised floor and HVAC to simulate Array Operations Site Technical Building.

- Continued design for fiber optic cable choice and fiber optic cable management plan for AOS (Array Operations Site). Commenced reviews of fiber optic cable management plan for cable inside the AOS TB (Technical Building).

- Internal Fibre system design passed first progress review. Scope has been extended to fully support the ACA (Atacama Compact Array) and ALMA-B correlators integration for Array Wide Subarraying

- Completed construction and initial testing for DTS formatter and de-formatter re-designs using ½ transponders for transmission and reception of optical signal.

- Two DG assemblies were refurbished to correct bandpass slope and to reduce sensitivity to input power voltage. M&C communication has been added to all four prototype units.

- First batch of pre-production Digitizers (28) boards and DG service boards (12) produced and under test.

- Pre-production Digitizer Clock assemblies (6 units) assembled, tested and internally accepted.

- Pre-production DTS optical multiplexers (3 units) assembled, tested and internally accepted.

- One DG Test Equipment (DTE) has been provided to NRAO by Universite' de Bordeaux to support tuning/integration of the DG. Four more test units are being manufactured (ready Apr. '06).

- Pre-production DTS EDFA/Optical Demux assemblies (3 units) delayed due to unavailability of AMBSI2 module and relevant information. Expected delivery Apr '06.

- Completed RFI analysis; documents are on EDM (Electronic Data Management).

- Assisted SE & I IPT in identifying missing or inadequately developed technical requirements for System Requirements Review (SRR).

- Continued documentation for pre-production modules; documents are being fed to a controlled area on EDM. Prepared a Verification Test Plan Overview for BE deliverables.

- Conducted Cost Review and schedule review; updated Production Plan.

- Prepared draft SoWs (Statements of Work) for production of BE modules for ACA, and for production assistance from ASIAA (Academia Sinica Institute for Astronomy and Astrophysics).

- Work continued on completing external ICDs (Interface Control Documents). Eleven are released of which 2 need revision, nine are on DAR, and four remain to be submitted.

5.2 Technical status and technical performance results achieved over the period.

- Tests on the four integrated IF downconverters received from Advanced Control Components show that the prototypes all meet specifications for gain slope vs. frequency. Detector linearity has been tightened for the next generation production hardware to conform with flow down of additional System Requirements which were not available at the time of the 1st prototype procurement. Newly designed housings for the IF downconverter modules are a significant development in that they provide 50 dB of RFI shielding up to 14 GHz.

- Two LabView controlled, automated IF Downconverter (IFDC) Test Sets were built, one for the comprehensive IFDC verification tests for gain parameters, dynamic range and signal-to-noise ratio; and one for Total Power Detection circuit boards.

- End-to-End Phase Drift Measurements were completed in combined BE/PS-I tests with the following results:

    - For the static case (no moving fiber) the 1st LO photonic reference system line-length correction subsystem worked as planned, within specification, and gave no measurable addition to the phase drift of the system.
    - A preliminary fiber wrap was tested that gave adequate results over sufficient range of motion. This gave confidence to the already initiated fiber-wrap work.
    - The amount of phase drift induced by the fiber motion gave no measurable addition to the phase drift, and met the large-angle slew phase drift specifications.
    - P-SI end-to-end Phase Noise measurements indicated that the prototype ALMA Laser Synthesizer met the ALMA phase noise specifications.
    - As a result of phase noise tests on the Central Reference Distributor (CRD), Central Reference Generator (CRG), and LO Reference Receiver

(LORR), a clean-up loop was added to the 2GHz reference needed by the LORR to phase lock the comb lines and the loop bandwidth of the 125 MHz PLL was decreased to improve the phase noise of the reference. The CRG, CRD, LORR and LO2 (2nd LO synthesizer) now meet phase noise requirements when setup as a subsystem.

- Design revisions to incorporate COTS ½ transponders on Digital Transmission System formatter and deformatter circuit cards were completed, the initial boards constructed, new firmware written, and the new DTS links tested successfully. The change reduces the overall circuit board count and eliminates adjustments required on the old laser and diode boards.

- Teraxion has proposed a modified design for the Laser Synthesizer to improve performance and reliability while keeping cost and schedule targets. The design study, on EDM, also describes a successful hardware demonstration and provides an accurate, comprehensive modeling of phase noise. At the request of the Bilateral BE, NAOJ (National Astronomy Observatory of Japan) BE is working on a Laser Synthesizer back-up plan using DSB-SC (Double Side Band – Suppressed Carrier) and $LiNbO_3$ modulator techniques.

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 re-design during the production cycle.

- A complete e2e test for BE has yet to be performed. 1) Problems with integrating the digitizer assembly, digitizer clock, and DTS (Digital Transmission System) formatter remain to be fully identified and solved, 2) Cable wrap assemblies and a laser synthesizer remain to be delivered for LO Photonics, 3) Timing and LO reference problems remain to be identified and solved, and 4) Standards are still emerging for CAN bus wiring, Monitor and Control hardware protocols, grounding, and power wiring.

- Polarization mode dispersion and fiber temperature sensitivity on uncorrected fiber sections in the central building and in the Front End could result in phase drift performance less than requirements. PSI testing is planned.

5.4 Planned activities for next period (January – March 2006)

- Complete procurement for pre-production modules.
- Begin preparation of Acceptance Plans for pre-production modules.

- Complete preparation of verification test plans for prototype SI (System Integration).
- Continue verification tests of prototypes for prototype SI.
- Begin tests of antenna fiber cable wrap prototype.
- Procure and begin assembly of remaining components needed for build of AIPC1 (Antenna IPT Test Designation) racks to be used for form fit in Vertex production antenna.
- Receive & review contracted Central LO seismic floor support design.
- Commence build and test of photomixers with new batch of u^2t (vendor name) photodiodes.
- Deliver 2nd laser synthesizers to prototype SI, and initiate procurement for production model, to include the microwave reference.
- Initiate procurement of production model of master laser and laser synthesizer.
- Identify and correct problems with synchronized reception (phase sensitivity) of Timing Event (48 ms TE) and 125 MHz LO reference.
- Continue with design of fiber optic cable choice and fiber optic cable management plan for AOS. Plan review of fiber optic cable management plan for cable inside the AOS TB (Technical Building). Complete ICD (Interface Control Document) with Site AOS TB.
- Ship DTS de-formatters (new design) to Charlottesville for 1 rack of 1st correlator quadrant.
- Identify and correct control problems with BE power supplies.
- Continue conducting DTS digitizer assembly/digitizer clock/formatter system integration tests; identify and correct problems.
- Continue testing RFI (Radio Frequency Interference) performance to verify compliance with RFI analysis.
- Initiate design modifications, where necessary, when results of Project System Requirements Review (SRR) are complete.
- Receive pre-production photonics LO photomixers (40 units) from RAL.
- Receive pre-production digitizer assemblies (32 units) from University of Bordeaux.
- Receive pre-production Digitizer Clock assemblies (6 units) from IRAM (Iinstitue for Millimeter Radio Astronomy, France).
- Receive pre-production DTS optical multiplexers (3 units) and EDFA (Erbium-doped Fiber Amplifier/Optical Demux assemblies (3 units) from JBO (Jodrell Bank Observatory.
- Complete the Internal Fibre system design.
- Finalize the plans and perform the Fibre splicing trials on site.

- Select the Master Frequency Standard Supplier. Decide on M&C (Monitor and Control) interface.
- Continue negotiating completion of external ICDs.
- If received, respond to NAOJ SoW for delivery of BE modules to ACA. Start procurement of ACA long lead/disappearing items (STm) (vendor) ASICS (custom-designed integratred circuit). Develop consensus on best configuration for Array Wide Subarraying, using both ACA and Bilateral Arrays.
- If invited, prepare SoW for off-loading certain NA BE production work to ASIAA.
- Assist AIV (Assembly, Integration, and Verification) with preparation of temporary Central LO and test plan for 1st antenna at OSF, where requested and direction provided.

5.5 Milestone Summary

Back End	9105	1.05.262	Install BE Hardware on Two ALMA Prototype Antennas at the ATF	Planned	1-May-04	15-Mar-06	ESO & NRAO
Back End	9122	1.05.305	Deliver Back End Assembly, Test, & Verification Plan	Planned	30-Nov-04	30-Jun-06	ESO & NRAO
Back End	9120	1.05.260.0055	All NA BE Production Contracts Placed	Planned	1-Jan-05	5-Mar-07	NRAO
Back End		1.05.305	1st antenna racks (A & D) ready for shipment to OSF	Planned	15-Mar-05	1-Nov-06	ESO & NRAO

6 Correlator IPT

6.1 Achievements

The goals for the last reporting period were:

(1) Continue board testing in the background for the second and third quadrants as production boards are received;

(2) Install all signal cables in first quadrant racks and perform integrated testing;

(3) Test prototype TFB card in a first quadrant station bin;

(4) Continue Test Fixture and test display programming for TFB card testing;

(5) By agreement with the Science and Computing IPTs, define the operating modes which will be supported by the first delivery of firmware and software;

(6) Write a correlator test and acceptance plan.

The status of these goals is as follows:

(1) Accomplished (ongoing activity). All production boards have been received and nearly all have been tested for all 4 quadrants.

(2) Accomplished. One section has been left configured like the 2-antenna correlator in order to test 2-antenna software locally in preparation for its use in PSI.

(3) Accomplished (testing continues).

(4) Accomplished (testing continues). The Stratix II version is under test in the Test Fixture.

(5) Accomplished to first order. All basic modes listed in the correlator specification are enabled. Requirements for the correlator software which will control the tunable filters have been reviewed but still need final approval.

(6) Not completed. This was delayed by Ray Escoffier's retirement, but most of the elements are already written and little extra work should be needed.

In addition, the following tasks were accomplished during June-December 2005:

(1) Rich Lacasse began work (~1 day per week) as a partial replacement for Ray Escoffier; he will be nearly full time beginning in July 2006.

(2) Burn-in testing revealed that 1 wafer run of ALMA-1 custom chips has a higher infant mortality than the other runs, although the failure rate for the worst case still meets industry expectations for this technology. Extended burn-in testing for additional boards was started in preparation for Quadrant 2 assembly.

(3) The redesigned clock distribution system now meets requirements.

(4) Assembly of Quadrant 2 began. The present plan is to complete each rack in the general correlator lab, then move them one at a time in the correlator test room.

(5) Development work on software and firmware continued with satisfactory progress to improve performance.

(6) The correlator planning became the first test case for using Cobra within PMCS.

(7) The automatic clock-phase setting software was successfully tested.

6.2 Status and results

6.2.1 Procurement

Essentially all the hardware has been completed except the following:

- Assembly and integration of racks for Quadrants 2-4.
- Production Tunable Filter Bank cards: prototype cards fabricated and tests ongoing.

6.2.2 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.

PRODUCTION CARDS					RECEIVED
CARD TYPE	REV	Required	Spares	Requisitioned	As Of 1/9/2006
6U POWER	C	128	12	140	**140**
9U POWER	C	64	6	70	**70**
MEZZANINE	B	512	23	535	**535**
FILTER (ORIGINAL SINGLE OUTPUT)	A	8	2	10	**10**
STATION	B	256	14	270	**270**
SCC	B	64	6	70	**70**
CORRELATOR	A	512	25	537	**537**
LTA	C	64	6	70	**70**
STATION INTF	B	128	12	140	**140**
CORRELATOR INTF	B	512	15	527	**527**
QCC	C	4	2	6	**6**
QUADRANT POWER CC	A	4	2	6	**6**
FINAL ADDER	A	8	2	10	**10**
DATA PORT INTF	B	16	4	20	**20**
STATION MOTHERBOARD	B	64	6	70	**70**
CORR MOTHERBOARD	B	64	6	70	**70**

2211 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.

6.2.3 Tunable Filter Bank (TFB) development

Test display programming for TFB cards acceptance with the Test Fixture was completely debugged and refined. Different VHDL versions of the filter designs have been edited and validated with the Test Fixture and the Correlator. Requantization in the filter final stage is operational for all filter modes, including bypass mode.

Our major task during the period was the design, fabrication, and testing of the Stratix II card version (latest 90nm technology) in order to improve power dissipation performances. All communication and spectral analysis tests listed in our 'Test manual for TFB' have been successfully performed. This new filter design also includes a circuit to monitor possible Single Event Upsets (SEU) in the FPGAs.

All tests indicate that the Stratix II version greatly improves the overall filter card power dissipation to meet requirements in the Correlator environment.

Other Stratix II cards are being assembled to confirm first results.

6.3 Highest level risks and concerns

There are two potential concerns for integration and checkout of the first quadrant before disassembly for shipment to Chile: the TFB cost, unless the production contracts are signed (as expected) in the first half of 2006, and the DTS receiver card schedule. We have determined that, although complete integration with all TFB and DTS cards for the first quadrant at the NTC is desirable, it would be acceptable to do the remaining integration later in Chile. The present plan is that at least one complete station rack will be tested before any shipment to Chile occurs.

6.4 Planned activities for next period

The goals for January-March 2006 are:

(1) Continue board testing in the background for the third and fourth quadrants as production boards are received;

(2) Continue burn-in of ALMA-1 chips and replace those which fail;

(3) Continue development of firmware and software;

(4) Complete at least one rack of Quadrant 2;

(5) Complete the test and acceptance plan;

(6) Continue testing the Stratix II version of the TFB card and make a decision about final selection of FPGA components for production.

6.5 Milestone summary

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

The first quadrant is expected to be ready for disassembly and shipping in June 2006. Disassembly must occur by the end of July 2006 in order to free space for assembly of the third quadrant, and we anticipate the first quadrant will need to go to storage at a location TBD until the AOS Technical Building is ready for it.

Since we expect to meet the schedule for delivery, no recovery plan is required.

6.6 Recent photographs

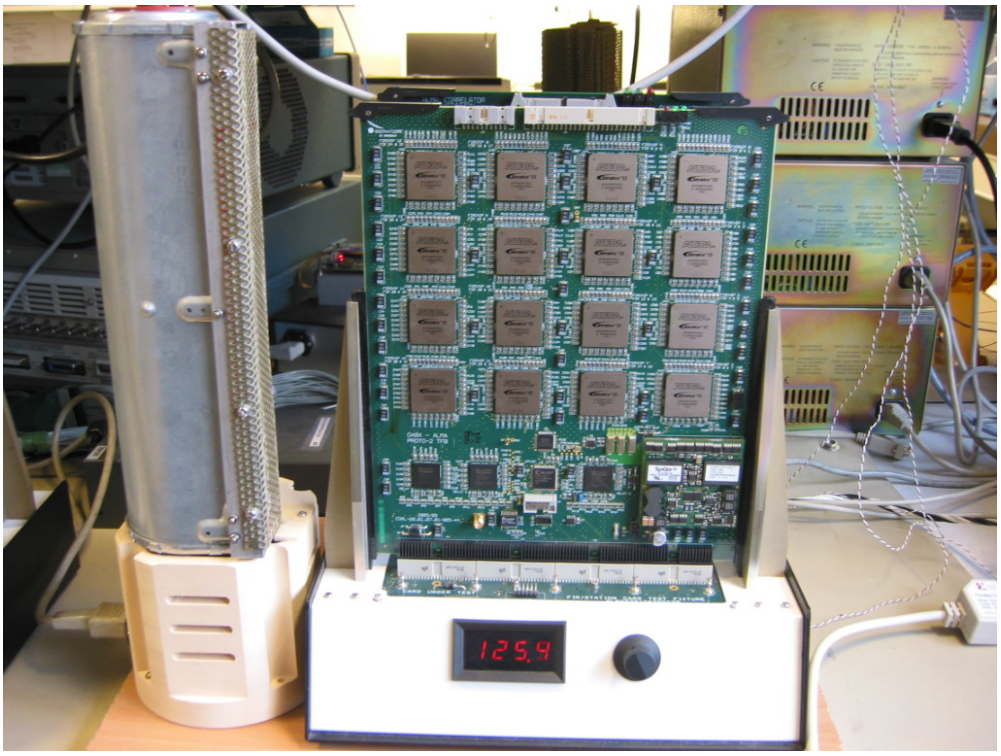


Figure: New digital filter card being operated slightly above 125MHz in the digital Test Fixture with laboratory fan on the left. This new card includes the array of 4x4 big Stratix II FPGAs (latest 90nm technology from Altera) and, visible at the bottom of the card, 3 delay chips, 1 CPLD2 and 1 circuit controlling SEU events in the FPGAs. The circuit at the bottom right is the DC/DC converter.

7 Computing IPT

7.1 Accomplishments this period

7.1.1 Whole IPT

- Concluded R3 development. It was 83% feature complete compared to plan for the release cycle. The major missed goal related to the ability to simulate hardware sufficiently across subsystem to enable complete simulation of single field interferometry in simulation.
- Supported PSI, and performed some hardware/software tests with prototype modules. Supported tests at the ATF, both in support of the AIPT, and as a test-bed for some integrated CIPT tests involving collection of archiving of monitor points from real hardware. MTBF of these tests increased from ~4 hours to >100 (i.e., no crashes seen in 100 hours when the test was stopped).
- Updated real-time and Linux operating systems to more recent versions.
- Presented several papers at ICALEPCS and ADASS conferences.
- Staff supplied by NAOJ (in-cash and in-kind) nearing completion in NA and EU.

7.1.2 CIPT management

- Completed rebaselining process and presented it to the cost review in Garmisch.
- Evaluated impact of two antenna vendors to the bilateral CIPT.

7.1.3 ALMA Common Software (ACS)

- Released ACS 5.0. This is a major release with many new features, for example a new alarm system adopted from CERN.
- Released patches (up to 4.1.4) to the previous release as required to support other subsystems.
- Provided considerable support to other subsystems. ACS team members assigned to Control tasks late in the reporting period to get more rapidly to the functionality which will be used for single field interferometry at the ATF.

7.1.4 Archive Subsystem

- User repository, including GUIs, implemented.
- Bulk store interface (which covers both monitor and correlator data) extensively tested (and system reliability improved) at the ATF and elsewhere. Implemented bulk distributer (to “T” high-volume data to multiple subsystems).
- Implemented archiving of system log messages into the technical archive.

7.1.5 Control Subsystem

- Completed level 2 and 4 tests of 2nd LO, FLOOG (including FTS) in PSI. A +/- 1 cycle discrepancy in the 125MHz signal vs. the 48ms Timing Event was discovered which is still to be resolved (it may only require a firmware change, TBD).
- Implemented Control Command Language, including binding to SB mechanism.

7.1.6 Correlator Software

- Implemented and tested first version of TFB support.

7.1.7 Executive Software Subsystem

- Implemented changes and supported use at the ATF.
- Updated SNMP monitoring support.
- Can now simulate the scheduling subsystem.

7.1.8 High Level Analyses

- Analyzed and documented event flows and sizes on the TWiki.
- Organized a team to work to improve overall software stability.

7.1.9 Integration, Test, Support

- Performed the technical integration of R3.0, including the preparation of first automated regression tests for the whole system.
- Analyzed the pros and cons of using Network File System between computers at the high and low site.

7.1.10 Observatory Operations Support Software

- Updated requirements based on approved Operations Plan. Held an internal CIPT review aimed at clarifying overall scope of the subsystem.

7.1.11 Observing Preparation and Support

- Created a spectral line editor/correlator setup tool.
- Created a wizard to support optical pointing tests.
- Integrated a first version of the visual spatial editor into the Observing Tool.
- Updated the ALMA Project Data Model.
- Implemented exposure time calculator for extended sources.

7.1.12 Offline Subsystem

- Updated the ALMA Science Data Model (ASDM) to accommodate optical pointing and to properly account for correlator binary data. Also created a Java browser for the ASDM.
- Python framework implemented and in internal test.
- Data Capture/Archive interface implemented.

7.1.13 Pipeline Subsystem

- Differences between Glish/Python flagging heuristics regression tests resolved.
- Initial versions of calibration and calibrator imaging scripts implemented.

7.1.14 Scheduling Subsystem

- Manual mode (pick an SB from a GUI) implemented.

7.1.15 Science Software Requirements Committee

- Improved subsystem requirements in several areas (correlator, science archive, pipeline).
- Discussed requirements arising from the ACA.
- Developed an Optical Pointing Use case.

7.1.16 Software Engineering

- Updated TWiki and Software Problem Report (based on Action-Remedy) software.
- Supported build system (makefile issues) and other development tools.
- Night Reporting Infrastructure extended to separate the realtime from non-realtime components.

7.1.17 Telescope Calibration Subsystem

- ASDM to TPOINT format file conversion implemented.
- Side band ratio calculation engine implemented.
- Implemented Calibration Data Model classes.

7.2 Activities next period

- R3.1 software prepared, checked in, and tagged, but not yet integrated.
- Offline and Pipeline external user tests concluded.
- Optical pointing integrated test performed at the ATF.

- Conclusion of first stage of software stability initiative, with improved robustness and tests.
- Required support for PSI and ATF activities.

8 System Engineering and Integration IPT

8.1 Management

- The main management activities were interfacing with the JAO, the executive PM and the IPT management and reporting and planning of the next activities. Input was given to estimate the impact of two ALMA-B antennas on the ALMA activities and for the ALMA risk register.

8.2 Engineering

8.2.1 Requirements and ICDs

- The following table summarizes the current status of the project-wide specification development. There were no changes in the last two months.

Project Wide Specification Status	31-Dec-2005	31-Oct-2005
Approved	27	27
Submitted	9	9
Draft	0	0
not started	0	0
Total	**36**	**36**
Completion status	**91%**	**91%**

- The following table summarizes the current status of the ALMA external ICD development, excluding the ones with ACA. The completion status changed as two new ICDs were identified.

ICD status	31-Dec-2005	31-Oct-2005
Approved	28	26
Submitted	13	14
Draft	5	4
Not started	5	5
Total	**51**	**49**
Completion status	**76%**	**75%**

- Several system requirements follow-up meeting were done to allocate the work

8.2.2 Design and Analysis

- SE&I IPT participated and/or chaired the following technical meetings:

- 12m ACA antenna CDR.
- ACA system PDR.
- Transporter review.
- AEM antenna Kick off Meeting.
- Receiver Cabin lay-out review and ALMA antenna equipment cabling review.

- Front End dPDR report was prepared and distributed.

- The system performance budgets were further detailed and a first version was released and distributed. The system performance budget update includes:
  - Decoupling of system budget from lower-level budgets in order to prepare release of Level-0 System Budget.
  - Concluded the integration of LO integrated test results into LO budget.
  - Correlator modes are now included in the performance budget.

- Started End-to-End Synthesis of 1-st LO Span Performance Budget (Optical Link Budget and 1-st LO PLL). Although this link is crucial for the system performance (noise and drift) there appear several design issues not consolidated enough at this stage, including the important selection of the photo mixer with its figure-of-merit.

- The 3-dimensional model of the Vertex antenna receiver cabin with its interior has been updated and refined and a draft document 'Receiver Cabin Equipment Mechanical Interference Study' updated. This document was distributed to Front End, Back End, Antenna and Computing IPT for comments and a review was held mid of December.

- Support was given to the Front End IPT to prepare a FESS analysis. The mechanical tolerance budget was further developed and refined.

- The ALMA master frequency standard MFS unit was configured based on a Symmetricom configurable clock. This unit is able to meet the available MFS specification.

8.2.3 Configuration Control and Documentation Management

- The CCB had two meetings via telecon. Due to urgent document updates and approval for the antenna and antenna transporter contract signature some

documents were also approved through email. In total two ICD, one specification and two CREs were approved the documents updated and released.

- The ALMA electronic document management system responsibility and operation is now done at the JAO office in Chile. Only in emergency cases or when specifically required additional support is provided by ESO.

- A preliminary inquiry was carried out for the ALMA computerized maintenance management system CMMS. A report summarizing the results and findings was prepared and the specification and SoW updated. The next step is to agree on the specification, SoW and procurement strategy ALMA project wide and start then the tendering process.

- Support was given specifically to the antenna IPT to update and finalise the documentations needed for the antenna and antenna transporter contract signatures.

- Ten change requests against project level documents were prepared. All are in technical discussion, but none of these was finally approved.

8.3 Product Assurance

- No progress was made on the reliability calculations. Other PA activities were covered by the SE personnel until a new ALMA PA responsible is recruited. ESO has hired a new PA person, who should also be available for ALMA part time. NA has advertised for a person to take the lead role in PA.

8.4 Prototype System Integration

8.4.1 Current Activities

- Two Line Length Correctors (LLC) modules, which are part of the 1st LO Photonic Reference system, were delivered to the PSI lab in Socorro for integration. The laser synthesizer and master laser were successfully phase locked, but a second laser synthesizer was sent on to the NRAO BE photonics lab in Charlottesville for upgrade.

- New ½ transponder versions of the DTS transmitter and receiver were installed on one link in the PSI system. Data was successfully delivered from the analogue input of the IF processor through to the correlator, but the system

remains unstable, and seems very susceptible to timing changes in the various distributed reference signals.

- The central LO racks were rewired to the configuration that will be used when the PSI system is moved to the ATF for testing on the prototype antennas. Modules were rearranged to maximize airflow and cooling.

- The ALMA Monitor Bus (AMB) wiring in the PSI racks and modules is in the process of being upgraded to improve the reliability of monitor/control communication. The major changes are: a) adopt a standard impedance 100 ohm cable to minimize reflections, b) remove the stub topology to minimize reflections, and c) upgrade the standard interface card (AMBSI-2) to include a filter to prevent interfering signals to propagate between modules on the AMB cables.

8.5 Chilean Assembly Integration and Verification

- Chilean AIV planning continued through discussions with the antenna IPT about acceptance and verification of the antennas and through first talks with Japan about the integration of ACA into ALMA bilateral AIV planning.

- Plans were developed for an Interim AIV Lab which can be used to be able to support antenna acceptance and early integration of antennas while the delayed OSF Technical Facility is completed.

- Planning underway for an OSF holography facility which will be able to support acceptance tests at all three antenna vendors as well as at the OSF maintenance pads.

- AIV staffing plan is under development toward making the first AIV hires in the first half of 2006.

9 Science IPT

9.1 Planned versus actual accomplishments over the period

- During the Period 2005-July through 2005-December, a JAO Project Scientist turno system was implemented. Under this system, one of the three regional project scientists performs the duties of the JAO Project Scientist for a period of four months, during which they spend at least three weeks in the Santiago JAO office. Wootten served the first shift, extending from September through the end of the year. Wilson will follow for the first months of 2006.

- The Science IPT assisted the ASAC in responding to its Charges from the ALMA Board, providing a statement on the proposed Baseline Change Proposals (BCPs) for example. While in Santiago, Wootten, consulting with ASAC Chair Testi, prepared the agenda and attended the ASAC face-to-face meeting held there Oct 1-2 and the ALMA Board meeting in early November. At the Board meeting, he reported on the Scientific Requirements document, on the new configuration design, on BCPs, and on the science effects of the two ALMA antenna designs, including for example the dissimilar quadripod position angles. As JAO Project Scientist, Wootten interacted with the Chilean science community. For example, he attended a colloquium at the University of Chile, an ESO-arranged meeting on Groups of Galaxies, and he presented an ALMA talk at the Latin American IAU Regional Meeting in December.

- The Science IPT leadership attended the ALMA Cost Review in Garmisch, where Wootten made presentations on Science Requirements and on the Science IPT. In Japan, he served on the Review Panel for the ACA 12m CDR and the ACA System PDR. Emerson and Laing also attended, via telephone line. The Project Scientists and Instrument Scientists also served on the panel for the July System Requirements Review (SRR), which Emerson chaired and wrote the panel report. Laing attended FE Delta PDR in Garching.

- A new version of the ALMA Scientific Specifications and Requirements (ALMA-90.00.00.00-001-A-SPE) containing clarifications of items discussed by the ASAC and the SRR was produced in December.

- The Science IPT has participated in the ALMA rebaselining effort, with the Project Scientists attending Management meetings to provide comment on the dependence of ALMA Science on various elements of rebaselining activities. Within the Science IPT, planning centered on the creation of a new Work Element for commissioning activities, WBS number 3070. Wootten, Wilson and Kawabe serve on the new Operations Working Group, which had a first meeting in December.

9.2 Scientific Advisory Committees

- As planned, the Science IPT facilitated the ASAC report to the Board in Santiago, providing supporting documents, an agenda and presentations. The Science IPT also began arrangements for the January meeting. New members joining the ASAC included Jose Cernicharo and Susanne Aalto; Pierre Cox and Ewine van Dishoeck left the ASAC after many years of valued advice. Several ANASAC, ESAC and JSAC telecons were held.

9.3 Technical status and technical performance results achieved

9.3.1 Configuration, Antennas

- The Science IPT designed a configuration appropriate for 50 or 64 antennas. The plan requires only ~175 antenna pads, rather than the 216 in the approved configuration. The 151 pad configuration for the inner 4km delivered 2005-Aug-17 provides excellent imaging for 50 antennas, or with an additional 11 pads, for 64 antennas in the bilateral array. Holdaway provided a strawman design for the extension of this array configuration beyond 4km, optimizing it for highest resolution and imaging performance. This extension for 50 antennas requires an additional 24 pads populated with an additional 9 moves of 4 antennas. Otarola, Rivera, Stirling and Bravo conducted an on-site investigation of the pad locations, suggesting modifications to account for local terrain to Conway and Holdaway, who provided quick feedback. Holdaway will finish the extended configuration design in concert with the road and fiber design to optimize performance while minimizing cost.

One of the new pad positions is staked on Chajnantor.

9.3.2 Calibration

A review was held at IRAM 2005-Aug-25 at which it was decided to implement a two load amplitude calibration system, simpler than that proposed in Memo No. 461. Wilson, Laing and Mangum represented the Science IPT.

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

Several other memos relating to ALMA Calibration appeared:

- ALMA Memo No. 517, 520, 521, 529 were in last report.
- ALMA Memo no. 543.

9.3.3 Site Characterization

The aging complement of batteries powering the NRAO instruments were replaced in August by Roberto Rivera and Juan Bravo.

Figure (L-R Roberto Rivera, Juan Bravo, Angel Otarola, Alison Stirling) During the site campaign in August, the Science IPT crew poses for a photograph. ***We were greatly saddened to learn of the death of Roberto Rivera in an automobile accident near San Pedro on September 1. Roberto came to ALMA in 2001 and had worked under contract with the site characterization team, along with many colleagues investigating the Chajnantor site, impressing many of us and our colleagues with***

his drive, his talent and dedication and his conviviality. We will all miss him dearly and send our heartfelt condolences to his family and friends.

A campaign was carried out to measure vertical atmospheric profiles as simultaneously as possible to verify the plan for meteorological instrumentation on Chajnantor. Tragedy struck the site characterization group shortly after the successful conclusion of the campaign when Roberto Rivera was killed in an automobile accident (see Figure 2). While in Santiago, Wootten met with Nyman to plan the shutdown of site characterization.

9.4 Science Requirements

During this quarter, the Science - Specifications and Requirements document, ALMA-90.00.00.00-001-A-SPE, was sent to the ASAC for comment, received in their Nov report. More detailed science requirements were developed the Nutator (ALMA Nutator Scientific Requirements SCID-35.03.00.00-001-A-SPE) and the process was begun for the radiofrequency membrane covering the antenna Cassegrain aperture, and for the quarter wave plates. One new project was submitted, refereed and catalogued to the DRSP collection; one remains in referee queue. Emerson led a series of telecons to provide plans for holography in Chile.

9.5 Organization, interaction with other IPTs

Telecons were held with other IPTs on a number of issues, including Frequency Switching requirements, requirements for Holography at the OSF and Nutator requirements. Ocampo and Grubb, from the PMCS group, met often with Wilson and with Wootten to discuss Science IPT organization in preparation for Cost Reviews. Wilson worked out details of agreements between IRAM, Cambridge University and ESO in conjunction with the EU FP6 program 'ALMA Enhancement'.

9.5.1 ALMA Memos Published July-December 2005 by Science IPT members.

543 Estimating Calibrator Counts at 250 GHz Using MAMBO Observations of Flat Spectrum Quasars M.A. Holdaway, Chris Carilli, Axel Weiss, Frank Bertoldi 11/05
542 Height and Velocity of the Turbulence Layer at Chajnantor Estimated From Radiometric Measurements Juan Pablo Pérez 11/05
538 Array Configuration Design of the Atacama Compact Array Koh-Ichiro Morita (NAOJ), Mark Holdaway (NRAO) 10/05
537 Walsh Function Demodulation in the Presence of Timing Errors, leading to Signal Loss and Crosstalk D. T. Emerson 09/05
535 Simulation Series of a Phase Calibration Scheme with Water Vapor Radiometers for the Atacama Compact Array Yoshiharu Asaki, Masao Saito, Ryohei Kawabe, Koh-ichiro Morita, Youichi Tamura, and Baltasar Vila-Vilaro 09/05
530 Coherence Estimation for measured Phase Noise in Allan Standard Deviation H. Kiuchi 10/05

9.6 Meetings, Outreach and Public Education

Wilson met with a reporter for Suddeutsche Zeitung for an article on ALMA in conjunction with an article on Astronomical Instruments of the Future'.

A proposal was developed and submitted for an ALMA special session at AAS/Calgary, which is being held in conjunction with CASCA. D. Johnstone, J. Turner and A. Blain will speak. Meetings at which ALMA was represented include:

- Astrochemistry throughout the Universe: Recent Successes and Current Challenges 2005 August 29 - September 2; Asilomar, California
- REVEALING THE MOLECULAR UNIVERSE -- ONE TELESCOPE IS NEVER ENOUGH 9-10 Sept 2005, Berkeley, Ca
- Protostars and Planets V 24 - 28 October 2005 Hilton Waikoloa Village, The Big Island, Hawaii
- Mm/submm Techniques and Science session, at the URSI General Assembly 2005 October 23-29, New Delhi, India
- "IR Diagnostics of Galaxy Evolution". 14-16 November 2005, Pasadena, CA
- "Groups of galaxies in the nearby Universe". DECEMBER 5 - 9, 2005 - Providencia, Santiago, Chile
- Latin American IAU Regional Meeting 12-16 December, Pucon, Chile
- National Radio Science Meeting 4-7 January, Boulder, Colorado

There are several ALMA workshops which have occurred:

- "*Galactic and Extragalactic ISM Modelling in an ALMA Perspective*" held October 13-15 2005 in Onsala, Sweden.
- Physique stellaire avec ALMA November 14/15, 2005, GRAAL - Montpellier.
- Workshop on Submillimeter Astronomy and Receiver Technologies, held 8-10 Dec 2005 in Nanjing
- Inaugural Japan-Taiwan ALMA Science Workshop, held 15-16 Dec 2005 in Taipei.

9.7 Highest level technical and managerial risks and concerns

Issue	Probability Score	Cost Impact Score	Schedule Impact Score	Category
ALMA consists of only 50 antennas	3	8	6	Very High
ALMA consists of only 40 antennas	2	8	8	High
Phase mitigation techniques fail to meet spec	3	6	4	High
WVR phase mitigation techniques fail to meet spec	2	6	4	Medium
FS phase mitigation techniques fail to meet spec	3	6	4	High
Project Scientist	3	6	6	High

9.8 Planned activities for next period.

- Manpower – A first ALMA postdoctoral position in NA will be filled by Dr. Antony Remijan. An offer will be made to a candidate for the second position, beginning in Fall 2006. Negotiations with candidates to fill the European postdoctoral positions continues.

- Site – All salaries and travel for site characterization were deleted at the end of 2005. The instruments continue to collect data, which is harvested on an as-available basis.

- 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.

- Calibration – WVR prototypes will be installed at the SMA during the period January through April. They will be installed later at the ATF. In the Fall, there will be a meeting at Cambridge, UK, to examine the results.

- Imaging – The ASAC was asked to review the existing analysis for the polarization and mosaicking performance of the hybrid ALMA array and consider

the priority and timescale for further analysis by the Science IPT. The Science IPT will assess the resources necessary for a full electromagnetic simulation of the antenna designs to investigate polarization and mosaicking with the bilateral array.

- Outreach – ALMA presence at the North American URSI meeting, at the AAS and at the IAU is being coordinated. An ALMA workshop on "From Z-Machines to ALMA: (Sub)millimeter Spectroscopy of Galaxies" was held on Friday & Saturday, Jan 13-14 2006 at NRAO-CV. There were 80 registered participants. During the March 26-30 meeting of the American Chemical Society, A. Remijan will present an invited paper on comet chemistry. During 2006 Q2 a workshop will be held on Complex Molecules in Space: present status and prospects with ALMA on May 7 to 11, 2006 at Fuglsoecentret, near Aarhus, Denmark. Beasley will represent ALMA at 'Future Directions for Millimetre Astronomy in the Southern Hemisphere' to be held at Chowder Bay, Sydney Harbour on 30 - 31 March 2006 and at SPIE 24-31 May, Orlando, Florida. At the joint CASCA/AAS meeting in Calgary in the Spring, there will be an ALMA special session featuring talks by A. Blain, J. Turner and D. Johnstone. C. Wilson will give an invited talk.