NATIONAL RADIO ASTRONOMY OBSERVATORY

Quarterly Report

January – March 2005

Cover Image: The Whirlpool Galaxy - the long tidal tail of neutral hydrogen was shaken loose by the dance of these two galaxies. Image courtesy of A. H. Rots (NRAO), A. Bosma (O. Marseille), J. M. vander Hulst (Groningen), E. Athanassoula (O. Marseille) and P. C. Crane (NRAO).

Table of Contents

Executive Summary

ALMA

In prior report periods, the ALMA NA project has experienced a significant turnover in personnel; turnover has stabilized in this quarter, led by the hiring of the new NA Project Manager (Adrian Russell, Charlottesville) and the NA Site IPT lead (Eduardo Donoso, Santiago). The hiring of a replacement NA Antenna IPT lead should be accomplished in the next quarter, which will complete the NA management/IPT lead-level hires.

The two largest issues currently facing the project are budget rebaselining and antenna procurement. The rebaselining is proceeding apace under JAO leadership with an anticipated completion later this year. A major part of the process includes the implementation of the Project Management Control System (PMCS), which is now available for early use. The first integrated project schedule (IPS) has been produced and is being reviewed, along with the corresponding cost data.

The antenna procurement also is proceeding toward a mid-2005 contract signing. Both Executives are together moving carefully through their respective procurement processes in accordance with their respective policies. Additional testing of the prototype antennas has been completed and the results used to enlighten the production procurement process.

The Array Operations Center (AOC) Technical Building bids have been received and are being reviewed for contract approval by NSF.

The Front End IPT has made steady progress on the Cryostat design and development as well as the Band 3 and Band 6 cartridges. At least one pre-production cartridge body for each of Bands 3, 6, 7 and 9 has been delivered. Lab tests of the prototype Water Vapor Radiometers (WVR) are being evaluated and will be presented at a PDR during the next quarter.

The Back End IPT has tested successfully the integrated ½ Transponder for the Digital Transmission System. The Central Reference Generator is being reworked to provide an improvement in phase noise performance for the microwave reference input to the laser synthesizer.

The Correlator IPT has completed a number of items, including bench testing and verification of 100% of the first quarter correlator boards with a few exceptions, receipt of the signal cables for the first quadrant, verification of the Tunable Filter Board (TFB) algorithms in the pre-prototype card, and testing of the first full prototype TFB card.

The Computing IPT progressed in user testing of the Offline (AIPS++) subsystem, Pipeline heuristics, the Executive subsystem, the Observing Preparation and Support subsystem ALMA Observing Tool, and the Telescope Calibration subsystem. All tests were successful.

Executive Summary

The Systems Engineering and Integration IPT has made considerable progress in completing the ALMA high-level requirements documents, ICDs and system integration planning and implementation, both at the New Mexico ATF and in Chile.

The Science IPT has produced an updated and expanded Calibration Plan, as well as a more complete version of the Commissioning and Science Verification Plan for assembly, integration, verification and commissioning of ALMA in Chile. The IPT also is developing a mitigation plan to produce an array configuration appropriate for fewer than 64 antennas, in the event that becomes necessary.

EVLA

The outfitting of the third EVLA antenna is nearing completion and the first EVLA Test Antenna has been withdrawn from service to upgrade its equipment to the current EVLA design. The Canadian correlator effort has completed a major milestone with the award of the contract for the design and fabrication of the EVLA correlator chip to a well-qualified company. It has been decided to use EVLA construction funds to provide 2 additional FTEs/yr for the e2e software effort. The use of EVLA antennas for routine VLA observing has been delayed due to the need for a redesign of the Digital Transmission System (DTS) module. New DTS modules will be available at the end of the next quarter.

Green Bank Telescope

Astrid, the Astronomer's Integrated Desktop, was released for staff evaluation at the end of the quarter. Astrid will provide a single control panel through which GBT observers will have access to all the applications, documentation, and feedback utilities that are required to conduct an interactive local or remote observing session. It greatly simplifies initiation of an observing session and the management of observing tools and their displays. As Astrid develops, it will allow interaction with the Observation Management database. To facilitate remote observing, Astrid was designed such that remote observers can launch the application on a Green Bank machine, run all processes on this machine, but view the displays remotely using the VNC protocol. Early tests have demonstrated good performance in remote applications.

Very Large Array & Very Long Baseline Array

The VLA control computers were relocated in order to make room for a renovation of the room that will house the EVLA correlator. VLA downtime during scientific observations, exclusive of EVLA antenna outfitting, was less than 2.5% of the scheduled antenna-hours of scientific observing. All VLA data now have been transported to the NCSA for eventual community access, and a trial program to image a subset of VLA data has begun. Reviews were held of a proposal for a new 190 MHz VLA observing system to study the Epoch of Reionization, and of a proposal for a demonstrator 20-88 MHz

station for the Long Wavelength Array, which would be built on the VLA site and tested with the existing VLA 74 MHz system.

The VLBA supported the descent of the Huygens Probe into Titan's atmosphere in January. Development of an operational capability for spacecraft navigation has been put on hold due to inadequate budget in NASA. The maser clock at Owens Valley was replaced, and a new, robust power system was developed for maintaining maser systems during their transport to VLBA stations. Preparations were made for a maintenance visit to St. Croix in order to repair severe rust damage at that antenna.

Central Development Laboratory

A new balanced low-noise amplifier for 2-4 GHz has been designed and built, and two units have been delivered to the EVLA for receiver prototyping. A second 211-275 GHz cartridge for ALMA has been completed and awaits testing. The first 211-275 GHz ALMA cartridge was successfully tested with the prototype IF switch. Plans were made for testing the first 211-275 cartridge in the first production ALMA dewar to get a head start on front end integration. The performance on the new L-Band feed for the EVLA is now understood from the theoretical perspective. Nearly half of the first quadrant of the ALMA correlator has been checked out. ALMA first local oscillators were delivered for Bands 3, 6, and 7. The LO for Band 9 meets specification over 80% of the required frequency range and development continues. Regular observations of the sun at 20-70 MHz continue, and work is proceeding on extending the frequency range.

Computing and Information Services

Computing and Information Services (CIS) personnel continued their efforts to provide robust computer and network security, providing increased user education and successfully managing the issues associated with the VPN (virtual private network (VPN) client software package that connects offsite systems to NRAO's internal network. Only a single computer security incident was reported this quarter, and it was rapidly resolved. The Observatory occupied its new Edgemont Road - Stone Hall facilities in Charlottesville this quarter. CIS staff went into high gear to re-wire the existing building. Significant effort was required to successfully re-locate employee computers and phones with minimal disruption and downtime to Observatory operations. Another significant milestone this past quarter was the CIS decision to upgrade the intranet backbone between Green Bank, Socorro, and Charlottesville from T1 to T3/DS3 service this summer.

Education and Public Outreach

Lee Shapiro resigned his position as Head of the EPO Division, effective March 1, 2005. Mark Adams (Assistant to the Director) will lead the EPO Division until a permanent replacement is hired by

the Observatory. Andrea Gianopoulos joined the EPO staff in January as a Public Information Officer (PIO). The Observatory has also created an "EPO Scientist" role to provide scientific guidance for EPO programs; NRAO scientist, Juan Uson has agreed to serve in this capacity. The Legacy Imagery Project continued to explore radio data visualization techniques and produced several compelling radio – optical composite images. The Science Museum Outreach program module that will deliver NRAO press releases to the more than fifty science museums and planetariums that subscribe to STScI's *ViewSpace* multimedia program will debut by June 1, 2005. EPO staff collaborated with scientists across the astronomical community to produce and distribute ten press releases on a wide range of excellent science and Observatory news this quarter, including NRAO's key role in the Cassini-Huygens mission at Saturn. EPO distributed four press releases at the January AAS meeting, and NRAO scientific results were featured in two AAS press conferences. The NRAO and National Youth Science Foundation proposal to jointly operate the 2005 West Virginia Governor's School for Science and Mathematics (GSMS) was selected and awarded $115,000. Compared to the Jan – Mar 04 quarter, visitation at the Green Bank Science Center increased slightly; visitation at the VLA Visitor Center decreased slightly. Gross revenues decreased at both centers. EPO and other Observatory staff participated in a wide range of community service activities this quarter, including mentoring, teaching in local schools, enrichment activities, special tours, science fair judging, and invited talks.

Environment, Safety and Security

ES&S provided support at the Antenna Test Facility for ALMA affected personnel to allow access to the prototype antennas and to ensure proper use of heavy equipment. ATF access procedures were finalized and controls established to assure employee safety. This quarter focused efforts to ensure safety in Socorro was appropriately addressed with the departure of a long time safety officer. This included sessions for supervisors on their role in safety. ES&S compiled the annual emissions of the site diesel generators and submitted the 2004 year total on the EPA New Mexico Air Quality Bureau Emission Inventory Report. In Green Bank, ES&S became involved in the MIT-LL-NRAO 43 meter project. In Charlottesville, ES&S provided Fire and Life Safety sessions on proper evacuation and response actions for emergencies. The Edgemont Road State Fire Marshal inspection was completed and all items identified necessary to obtain the certification for use and occupancy was achieved. Next quarter, ES&S will begin to provide service to the Joint ALMA Office to develop the ALMA Safety Program.

Science Highlights

Very Large Array

VLA Provides Key Data on Magnetar Outburst - When the Soft Gamma-ray Repeater SGR 1806-20 underwent a giant flare on December 27, 2004, the VLA became the prime tool for studying the burst's afterglow, in part because the object was at the time too close to the Sun in the sky for many satellite observatories to safely observe. Two teams, including 33 investigators from four continents, used the VLA to study this object, a magnetar. Results from the early observations include measurement of the fireball's expansion speed (0.3c); estimates of the total energy of the flare; a non-spherical and possibly changing shape for the fireball; and polarization measurements. HI absorption measurements by one team possibly have called into question the generally accepted distance to this object, with significant implications for models.

Very Long Baseline Array

VLBA Measures Proper Motion, Rotation of M33 -Using VLBA observations made over a period of 2.5 years, astronomers have directly measured both the proper motion and the rotational motion of M33. This is the first proper-motion detection ever made of a galaxy not a satellite of the Milky Way. Combined with radial-velocity measurements, this work provides the first three-dimensional measurement of the galaxy's motion in space. M33 is a satellite of M31, and this work will refine the orbit of M33 and help determine if it has undergone close encounters with M31 in the past. The measurement of such minuscule angular motion was done by observing water masers in interstellar clouds within M33.

Investigators: Reid (CfA), A. Brunthaler (MPIfR, Bonn), H. Falcke (ASTRON), L. Greenhill (CfA), and C. Henkel (MPIfR, Bonn).

Green Bank

Detection of a Water Maser at z=0.66 - The GBT has been used to detect a water maser at a redshift of 0.66 in a Type 2 quasar discovered by the Sloan Digital Sky Survey. This object is more than an order of magnitude farther than any previously known water maser source. Such masers provide information on the nuclear tori and black hole masses of active galactic nuclei. In one case (NGC4258), studies of the water maser emission were used to make a precise distance measurement independent of the usual distance ladder. The spectrum of the new detection has only one emission feature and thus cannot be used for such distance measurements at the present level of sensitivity. Nonetheless, the detection now offers the possibility of finding other megamaser sources in the distant universe that could be used to test deviations from the Hubble Law as inferred from observations of Type Ia supernovae.

Investigators: R. Barvainis (NSF) and R. Antonucci (UCSB).

Management IPT

European Project Office

Personnel

- The search for a replacement of the European Project Manager is ongoing, meanwhile John Credland will remain in a part-time capacity until a suitable candidate is found.
- Jean-Louis Beckers resigned as European Project Control Manager with effect from the end of February 2005. Jean-Louis' contribution both to ALMA and to the ESO ALMA Division will be sorely missed. His place has been taken by Donald Tait who originally took up duties as Project Planner on 2nd August 2004 and who is rapidly coming up to speed on the financial aspects of his new post having previously been concerned purely with PMCS applications.
- A post for Donald's replacement as Project Planner has been advertised with a closing date of the end of March.
- Lutjens Popkin finally joined the ALMA System Engineering and Integration group on the 15th February on secondment from ESA and has been allocated the task of following the critical development of the Local Oscillator.
- An internal candidate for the Back-End Production Engineer has been recruited and will start work on a part-time basis at the beginning of April and will transfer to the ALMA Division by the year end.
- A second post for a Back-End Engineer has been released with a requirement for some experience in Fibre Optic engineering.
- Interviews for the candidates for the Antenna Production Engineer have been concluded and an offer made to an experienced candidate who should be fully up to speed rapidly after recruitment. A new position for an Antenna Engineer has been opened which will be filled by a candidate currently working for the IPT as a contractor.
- Volker Heinz joins the System Engineering and Integration team on 1st April and will initially be assigned to the Antenna IPT to cover work in Socorro on the Prototype Integration.
- Suitable candidates for secondment to fulfill the other short-term needs for experienced System Engineers are still being sought.

Contract Activities

- The ongoing evaluation of the responses to the Call for Tenders for the Antenna procurement has again been the major activity during the reporting period.
- Following the opening and analysis of the Financial and Contractual parts of the bids several questions of clarification were addressed to all bidders concerning the technical, managerial, financial and contractual aspects of the bids. Questions of clarification have been directed to all three bidders on the European side, both in meetings and by written procedure and responses analysed by the CAC. The questions covered topics such as a reduced number of antennas, incremental pricing for additional orders up to the original number of 32, variations in pricing

from Firm Fixed Price to Price Revision, Price Revision with a fixed ceiling and for all options the inclusion or otherwise of Penalty Clauses and Bank Guarantees.

- The report of the Antenna Technical Working Group (ATWG) under the chairmanship of Dave Woody was published in late September and included recommendations for additional testing to be done on one of the prototype antennas at Socorro. A Joint Antenna Technical Group (JATG) was set up under the chairmanship of the JAO to conduct an extensive test programme on both prototype antennas in Socorro. This group is expected to complete the measurement programme and data reduction and produce its report by late March.
- As a result of these further delays to the placement of the contract an extension of validity of all three bids was obtained until the 31st March, further extension will be necessary due to the ESO approval cycle.
- ESO expects to be in a position to place a Contract Proposal to the next scheduled meeting of the Finance Committee on 10th/11th May.
- During the reporting period meetings were held with institutes supplying major items of hardware to the ALMA project to confirm the expected pricing for the forthcoming production contracts. Despite major escalation of raw material prices since the original ALMA estimates were established, the majority of suppliers indicated adherence to the original estimates within 10%. Approval of the Finance Committee to negotiate directly with current suppliers was obtained at the November meeting in cases where a production quotation of similar magnitude to the original estimates is obtained thus obviating the need to go out for competitive quotations.
- The contract for production of the Cryogenic low noise amplifiers for both Bands 7 and 9 is currently under negotiation with CAY in Spain. The prototype amplifiers have met specification and full production can be commenced this year.
- The Call for Tender for the antenna transporter has been prepared and is due for issue in mid March. Finance Committee will be asked to approve the Contract Proposal by written procedure in late June in order to meet the delivery schedule.
- The Contract Proposal for the study of the Dual Fuel Power Station at the OSF will be presented for approval at the May meeting of Finance Committee.
- The presentation of the Contract Proposal for the provision of Technical Facilities at the OSF to Finance Committee for approval has been delayed until the November 2005 meeting without impact on the latest project schedule.

Technical and Managerial Concerns

Management

The interfaces between the ESO in-house ERP financial control system and ALMA need to be consolidated such that budget commitments in the ESO system are directly available to the PMCS for reporting.

ALMA

Site

Provision of facilities and utilities for the antenna contractor at the OSF need to be urgently defined with a formal Interface Control Document prior to placing of the OSF facility contract. Costing for these extra services should be assigned as a part of the rebaselining exercise.

A design revue of the options for antenna foundations is urgently needed in order to make a decision on which design to use for the OSF and AOS sites. The revue must include detailed cost assessment of the options.

Antenna

Delays in selection of the antenna contractor are severely impacting other activities which are associated with this decision.

Completion of the JATG antenna test campaign in due time to allow the output to be used in the CAC decision process is becoming critical. The bidders must be contacted before the bid validity expires at the end of March and the Finance Committee paper must be issued by 20th April.

Front-End

Agreement on the philosophy for the Front-End Integration Centres is needed to enable plans for the European Front-End Integration Centre to be consolidated. This action is becoming urgent if the Integration Centre is to be ready in time for the pre-production integration.

Delivery of a full specification Band 9 local oscillator multiplier is necessary in order that the delivery schedule of the cartridge assembly is maintained.

Back-End

The current problems being encountered on the prototype Local Oscillator design are beginning to affect the overall project. The resources available for the baseline design should be increased before pursuing any alternative design concept.

North American Project Office

Overview

Overall this has been a very busy and productive period for the ALMA project. Currently the two biggest issues facing the project are antenna procurement and overall cost. Consequently the rebaselining activities and prototype antenna testing have been given priority above all else.

In the margins of the ALMA Board meeting in Chile the two Executives and the JAO produced a memo clarifying reporting relationships; effectively delegating the necessary authority to the JAO Project Manager to lead the project technically whilst recognizing the role of the Executives in terms of line management, accountability and priority setting. This clarification has considerably benefited the project and has made the Management IPT functional.

ALMA

Personnel

Adrian Russell took up the post of North American ALMA Project Manager on 7th January 2005 and relocated to Charlottesville at the end of February. He was able to attend the IPT face-to-face meeting in Charlottesville in October and the ALMA Board meeting in Chile in November.

Simon Radford, the North American Site IPT lead resigned from NRAO to join the Cornell/Caltech 25m Telescope project. Eduardo Donoso was appointed to replace him and has rapidly established himself in the role. Another change in project leadership during the period was the successful hand-over of the Front-End (FE) IPT lead responsibilities from Charles Cunningham to John Webber. Dick Sramek has also successfully assumed the Prototype System Integration activities previously led by Larry D'Addario.

Victor Gasho resigned from NA Antenna IPT lead in February. His role is being carried out by Marc Rafal in the interim until a permanent replacement is hired. Marc Rafal has also resigned from NRAO, but is carrying out the Antenna IPT role under contract.

David Hubbard has assumed the deputy Project Manager role. Bill Porter's role as Business Manager within the North American Project Office has been strengthened.

Antony Davies has been appointed as NA Project Controller and will start on 21st March 2005.

Technical and Managerial Concerns

Management

The rebaselining exercise is progressing rapidly following a huge effort by all the Integrated Product Teams (IPTs) and the Project Management Control System (PMCS) team, with cost and schedule data being ingested into the new PMCS. For the first time an integrated project schedule has been produced, which is now in the process of being checked in detail. As part of the rebaselining exercise, detailed statements-of-work have been produced for each subsystem, both to ensure clarity on all sides in terms of deliverables, and to check for missing scope. In addition, a detailed project risk register is being produced.

The project will face some hard decisions as a result of this exercise, but will then be set on a sound planning basis. This, when coupled with the PMCS, will allow proper management tracking and control.

ALMA

Antennas

Getting an antenna contract in place remains the biggest single issue for the project. To this end and under the leadership of the JAO the JATG has performed an outstanding set of detailed technical measurements to clarify the technical performance of the two prototypes. This effort has been truly heroic, being carried out at very short notice, over the holiday period. Despite this the international team has carried out very careful measurements which demonstrate that these are the best antennas ever built.

It has been necessary to ask all bidders to extend their bids to 31st March. It is now clear that another extension will be required. Resolving this procurement is going to be a defining step for the ALMA project.

Site

Agreement was reached between the North American and European Executives to share the cost of scope and cost increases for the ALMA and Contractor Camp facilities at the OSF and the required Budget Change Requests were approved.

After considerable delay, the AOS foundation package is now under review at NSF and the placement of the contract is imminent.

Front-End

The absence of cold multipliers, meeting requirements, for the Band 9 cartridge has become a serious problem. These components are on the critical path for completing the first pre-production Band 9 cartridge. A prototype system was delivered, but alternate paths toward a final, complete solution will take several months to develop.

Back-End

There remains technical risk in the photonic LO system. Polarization mode dispersion and acoustic sensitivity problems with components in the Photonics LO design could result in phase noise performance less than requirements. A study to analyze and compare the performance of the current design with other schemes, such as an amplitude-modulated single frequency scheme is being considered.

Site IPT

Antenna Stations at the AOS

- The antenna station (foundation) design prepared by M3 based on the approved antenna station ICD substantially exceeds the budget. 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 in October 2004.
- There is need to reach a consensus between the two Executives as to how to proceed with the implementation.

- Both designs are currently being subjected to budget estimates prepared by local Chilean firms. A construction start prior to or by September 2005 will assure that a sufficient number of antenna stations will be completed to accommodate early operations.

Technical Building at the AOS

- Start of construction of the AOS Technical Building Foundation has been awaiting NSF approval of the contract..
- Construction should begin in August 2005, after the winter season.
- Completion of the bidding and "For Construction" documentation (Drawings and Technical Specifications) for the AOS building by architects M3 has been authorized. Work is progressing.

Permanent Access Road

- The construction of the formation level of the access road with ESO and rented equipment continued. As of to date approximately 28 km of modified road formation level has been constructed.
- This represents approximately 65% of the total length of the road of 43 km. Tendering for the construction of the remaining 15 km of modified road formation level is under way. The road pavement will be contracted out later (2007-2008).
- The OSF Technical Facilities site has been used as a borrow pit to obtain fill material for the construction of the elevated road platform crossing the Salar between km 0 and km 7. Tender documents for the construction of culverts and drainage structures at canyon crossings of the road to the OSF and the AOS are being prepared.

Figure 1: Formation level of the access road km 0 to km 7.

Figure 2: Road at km 24 (3,700 meters elevation).

ALMA and Contractors Camps at the OSF

- The ALMA Camp (EU) with a total of 15 beds, office, dining room and first aid facilities has been completed and all services including water supply, fuel supply, power supply, garbage removal, catering, lodging and cleaning services, safety and security services, camp and maintenance and management are functioning.
- Contracting for the extension of the ALMA camp to 30 bed capacity and the implementation of architectural features is under way. Projected construction start will be in March 2005. Completion is scheduled to be by the end of May 2005.
- Release of the bidding documentation for the completion of the contractor's camp will be during March 2005. The completion of the contractor's camp is scheduled to be in August 2005.

Technical Facilities at the OSF

- The tender documents for the construction of the Technical Facilities at the OSF have been approved by the Executives and released by the JAO in October 2004. In accordance with the latest Tender Itinerary release of the tender documentation to the bidders (European and Chilean) will be in early 2005. Closing date of the tender will be in late 2005 in order to obtain
- Finance Committee's approval for contracting in November 2005.
- Contract signature and start of work will be early 2006 and Provisional Acceptance is scheduled to be in late 2007.

- Mass excavation and crushing and selection of excavation material for filling will start at the beginning of March 2005.

Figure 3: Mass excavation upper and lower levels, status 7th March 2005.

Figure 4: Crushing operations to produce fill material have started. Fill area marked.

ALMA

ALMA Project Power Supply

- The proposals for the design and preparation of the Tender and Construction documentation of the permanent power generation and transmission system have been received at the end of September 2004. Tender evaluation has been completed. Clarification meetings with the low bidders were held in November 2004.
- Replies of the bidders have been received. The report of the Technical Evaluation Committee has been submitted. The report of the Contract Award Committee is being prepared. The matter will be presented at the ESO Finance Committee meeting in May 2005. The start of the design work would thus be in June 2005. Completion of the design work is scheduled to be in November 2005.

Construction Site Safety Services

- The service contract has been prolonged until the end of 2005. It is anticipated that a permanent safety engineer will be employed by ALMA during 2005.

Environmental Aspects

- A site visit of Chilean Authorities took place on 14th December 2004. The visit ended satisfactory. Another inspection of the Chilean Department of National Monuments is forthcoming in early 2005.
- Due to some old fox traps the road at km 30 may have to be re-routed.
- Blasting work for road construction is being coordinated with authorities and consultants.
- Torrential rainfalls have caused slight damage to archaeological site # 20. Corrective measures, i.e. change of the slope of the road and construction of a protective wall, are under way.

Figure 5: Protective wall at site 20.

Configuration Review

- The review and comments (mainly check of soil conditions at the revised configuration layout) on document ALMA-90.02.00.00-002-A-SPE Long Baseline (Y+) Array Configuration Specifications and Requirements are under way.

Concerns and High Level Risks

- Resolution of scope and budget issues AOS Technical Building;
- Resolution/Consensus of antenna stations design;
- Resolution/Consensus of joint camps running costs;
- Fiber Optics site layout and design by Back-End and Computer group;
- Postponement of the OSF Technical Facilities tendering;
- Budget;
- Integrated project schedule.

Goals for the next period

- Complete tender actions for the AOS Building and drainage structures as part of the access road.
- Tendering of the complete catering services (board, lodging, laundry, camp management and maintenance services) as part of the ALMA and Contractor's Camp operations. Projected service start is late 2005.
- Continuation of construction of the modified formation level of the access road all the way to the AOS until mid/end 2005.
- Start construction work for the foundations and structural steel of the AOS Building.
- Completion of Contractor's Camp, extended ALMA Camp and Architectural features of both camps by May 2005.
- Contracting for the design and preparation of tender and construction documentation for the power generation and transmission system (The Power Plant).
- Tender action for the construction of the OSF Technical Facilities.

Antenna IPT

Status

Production Antenna Procurement

- The Antenna IPT lead and deputy continued to be involved in the process of meeting with bidders in order to clarify content and issues of their offers and to explore ways to reduce the price by examining cost drivers associated with the Statement of Work. This is happening in close coordination between the two Executives and in interaction with their respective Selection Award Committees.
- Coordination meetings and teleconfrences have been held regularly between the Executives.

- As the bid cost exceeded the approved budget in both Europe and North America, the negotiations with the bidders include discussions about the number of antennas to be procured.
- Various contracting schemes are being examined.
- Following the first report of the Antenna Technical Working Group produced in September 2004, a series of tests was performed on the Vertex prototype. The AEC prototype was out of commission due to failure of the azimuth drive motors.
- This included quadrant detector measurement of the main dish surface and photogrammetry (by the Contractor). The results were cross-checked with Front-End analyses.
- In parallel, examination of the technical answers obtained by bidders continued.
- However, the results of the tests led to a general re-thinking of the tests performed to date. At a co-ordination meeting in December the two Executives decided to start a new campaign of tests on both prototypes including repetition of some of the tests performed previously by the Antenna Evaluation Group. This happened in order to ensure that the tests on both antennas were performed under near identical conditions. The test program included new holography runs, photogrammetry and Out of Focus beam maps to detect possible non-homologous deformations of the dishes with changing elevation.
- The results of the holography runs showed deformation in both dishes, compared to previous results obtained by the Antenna Evaluation Group. Taking this into account it was decided also to do an accelerated dynamic test of the main reflector, de facto pushing the completion of the tests toward the end of March.
- No further progress could be achieved in the evaluation of the life cycle costs of the various designs proposed by the bidders, compared to the costing report previously prepared by the IPT, due to missing information both in the bids and at ALMA system level.

Vertex Prototype Antenna

- The report on the Photogrammetry of the dish as performed by the contractor was obtained, but it did not fully explain discrepancies between the Front-End model predictions and obtained results. Similarly it has been difficult to reconcile the results of the Quadrant Detector measurement with the Front-End analysis.
- The repaired encoder repaired at BEI has been re-installed. A session of planned preventive maintenance is scheduled as soon as the antenna has completed the JATG testing program.

AEC Prototype Antenna

- In October the repair of the azimuth motors was completed in Italy. An inspection was done at factory, prior to shipment of the motor segments to the site. Shortly after AEC re-started their work on site. The motors were reinstalled, and a modification to the cooling system was performed to eliminate any similar risk in the future. The shimming of the base was completed successfully, with radical improvement of the behavior of the azimuth bearing. The elevation encoder was substituted with a new one and various software issues fixed.
- The antenna was fully operational at the end of November and underwent a complete program of acceptance testing. Provisional Acceptance was granted on 17th December.

Transporter

- Following the project review of the Transporter specification, Statement of Work and related documents at the end of September, the documents have been updated. Related to the previous Quarterly Report the completion of this activity has been shifted to the end of February. At the time of writing, the documents are ready and the Call for Tender is being issued. Of note is that last minute inputs from Japan concerning the Mitsubishi antenna were incorporated.

Nutator

- Due to the unsatisfactorily performance of the Nutator used with the prototype antennas it has been decided not to fabricate identical "build to print" units but to establish a Technical Specification and a Statement of Work for the production of revised units. Experience and design inputs from the existing nutator are likely to flow into the revised design. Work on these documents has started.

Personnel Issues

- The North American IPT leader, Victor Gasho, resigned effective end of February. The process for recruitment of a replacement has started.
- The search for a suitable candidate for the Antenna Production Engineer (EU) has continued. A contract has been offered to a selected applicant and the response is awaited.

Technical and Managerial Risks and Concerns

- Late delivery of antennas will delay level one milestone of 1st antenna available at OSF in December 2005. No economic way of recovering this schedule slippage has been identified.
- All antenna bids exceed the allocated budget. This will require further detailed negotiations with the bidders and will further delay the signature of the contract(s).
- Testing of the prototype antennas is not completed at the time of writing and therefore no fully conclusive statement can yet be made on the full capability of the two designs to fulfill the technical requirements.

Tasks During Next Quarter

Production Antenna Procurement

- Continue the activity related to the procurement and get approval to negotiate contract(s).

Transporter

- Issue Call for Tender, examine bids and get approval for signature of contract.

Progress on Milestones for Last Period

3.035.8545 Complete Technical Performance Report AEC
Under completion. It will be delivered by 31st March.

3.035.8569 Transporter Critical Design Review (prior to issuing Call for Tender)
Completed. Transporter documentation updated with all comments received by the CDR and Call for Tender planned for mid of March.

3.035.8565 Sign Contract for North American 31+1 Production Antennas
Further clarification obtained from bidders. The process is on hold pending the completion of the extended evaluation by the Joint Antenna Technical Group. This is expected to be finished by end of March, so that further decisions can be undertaken. The number of antennas to be finally procured is presently under discussion due to bids being higher in cost than in the approved budgets.

3.035.8575 Sign Contract for Euro 32 Production Antennas
Further clarification obtained from bidders. The process is on hold pending the completion of the extended evaluation by the Joint Antenna Technical Group. This is expected to be finished by end of March, so that further decisions can be undertaken. The number of antennas to be finally procured is presently under discussion due to bids being higher in cost than in the approved budgets.

Front-End IPT

Planned versus Actual Achievements

- **Integrated Product Schedule / Project rebaselining**
  As forecasted, the FE IPT schedule has been completed this reporting period. In early December a conclusive face-to-face meeting, attended by FE IPT Leader, Deputy and involved project planners, about the FE IPT schedule was held in Garching. The FE IPT schedule inside IPS is now in full operational use.

  Especially in December, substantial effort has been put into the rebaselining of the project. In close interaction with JAO staff various draft documents, e.g. statements of work, were prepared and submitted by the requested deadline of mid January 2005.

  In collaboration with EU and NA institutes, work on costs updates for the production work packages were completed.

- **FE Sub-System Engineering**
  FE sub-system engineers provided support to various ongoing activities, including:

- Providing ALMA-Japan with technical information for Band 4 and 8 cartridges;
- Update of existing and definition of new ICDs (Cryostat - Cryostat M&C, Quarter-Wave plate - M&C);
- Front-End integration and verification;
- Preparation of Cryostat CDR, review of CDR package, and actual CDR;
- FE sub-system MTBF analysis (in close collaboration with PA engineer from SE&I IPT).

- **Cryostat**
  A Critical Design Review of the ALMA Cryostat was held on 2nd and 3rd December 2004 at RAL in the UK. The preparation of this review was a major effort for RAL staff which went at the expense of the pre-productions tasks for cryostats and cartridge bodies. The final CDR report was issued. RAL is currently working on resolving the outstanding issues that were identified at the CDR. These need to be completed by 31st March 2005 to formally pass the CDR.

  RAL has encountered problems with sub-contractors who were not able to manufacture to specified requirements. Active collaboration of RAL with their sub-contractors resolved these issues.

  Delivery of at least one pre-production cartridge body to the Bands 3, 6, 7 and 9 cartridge groups has taken place.
  An improved design for the GFRP parts of the cartridges bodies, optimized for production, has been made and production has started. First parts have been used for assembly of Band 7 cartridges bodies and delivery of these is imminent.

  From 1st January 2005 Ferdinand Patt (ESO) has taken over from Gie Han Tan (ESO) as responsible work package manager for the cryostat assembly, including cartridges.

- **Cartridges**
  Band 3 cartridge #1: the cartridge was assembled, and testing began. The mixers in this cartridge came from the prototype wafer, and subsequent wafers have not been as good. Preliminary measurements with LO=96 GHz show noise temperatures of 38 to 45 K for two polarizations and two sidebands, using the ALMA production LO.

  Band 6 cartridge #1: there was extensive testing, including beam measurement. The noise temperatures and image separation are satisfactory, but an unexpected beam sidelobe was detected at the -15 dB level. Exhaustive tests using different windows and IR filters established that a reflection between the IR filters and the cartridge or cartridge test vacuum vessel is responsible. Further tests with different configurations were selected and are planned in the near future.

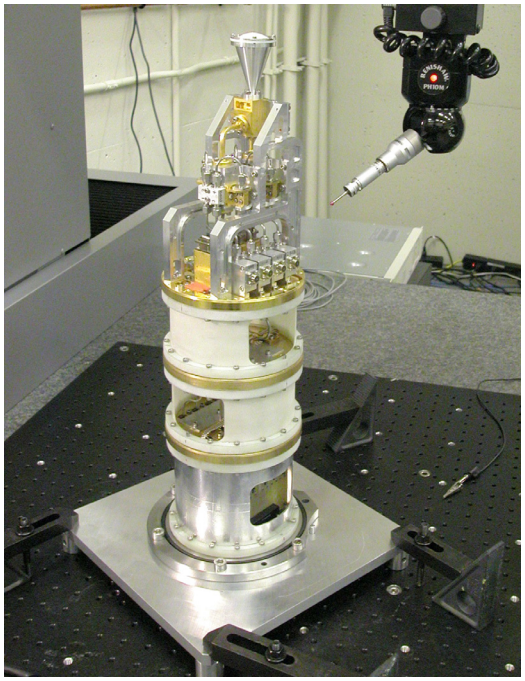

Figure 6: Band 3 cartridge #1.

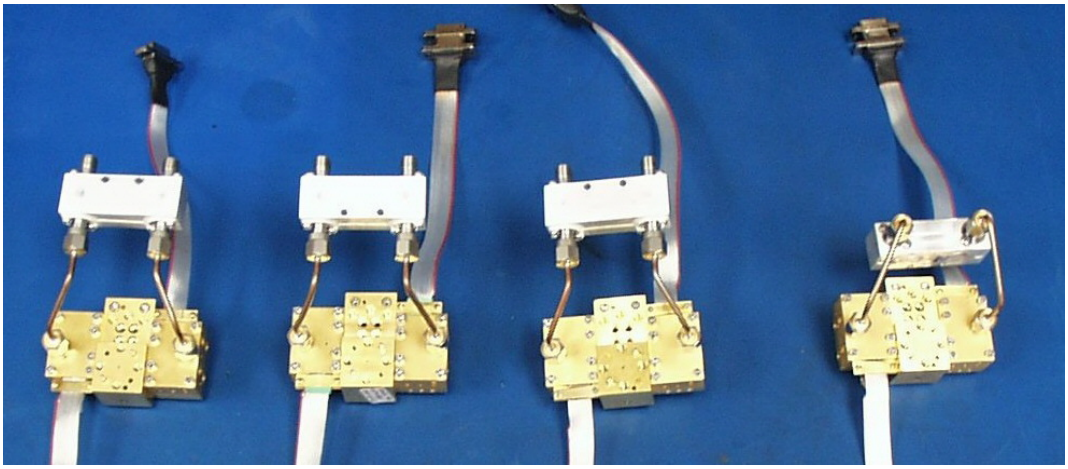

Figure 7: Tested Band 6 mixer-preamps for cartridges 2 and 3.

Assembly and integrated testing of a prototype Band 7 cartridge made reasonable progress. Small problems were encountered with the delivery of various components, e.g. wiring harness and cold optics, by sub-contractors to IRAM.

Also the assembly and integration of the Band 9 cartridge made progress as can be seen in the pictures below. While integrating the cartridge some minor design flaws were detected, the most serious one being that one mixer assembly was rotated by 90 degrees. All these flaws could be easily corrected and the engineering documentation has been updated. A prototype LO which provides only partial frequency coverage was delivered to the Band 9 group, but it has not yet been integrated.

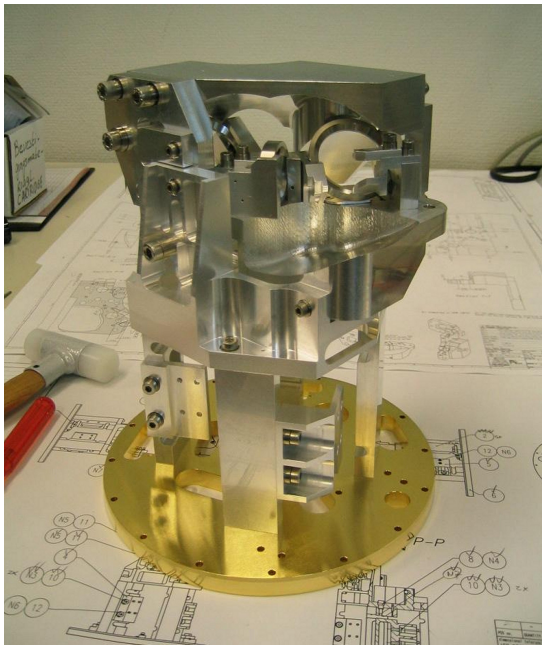

Figure 8: The Band 9 4K optics assembly.

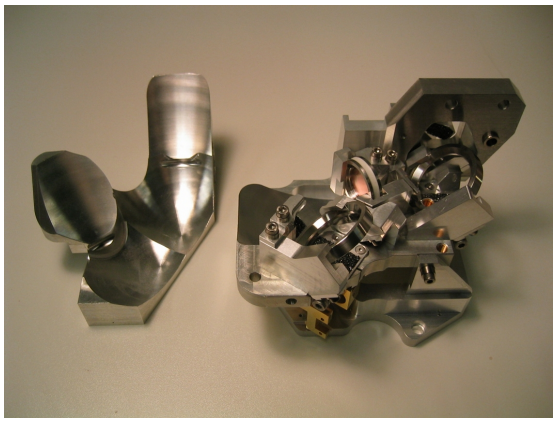

Figure 9: Disassembled view of the Band 9 optics assembly in which the machined mirrors can be seen.

- **Front-End Integration and Test**
  Work on detailed plans for the FE integration, verification and delivery to the project has started. Several teleconferences with the cartridge groups delivering to the FEICs have been held and draft documents describing the acceptance process, acceptance test plan and test procedures for the cartridges have been prepared.

  The IF signal processing electronics for FEIT was designed and procurement and assembly began.

  Documents describing the overall FE integration plan and planning are nearly complete. Due to the project rebaselining their completion was delayed.

  As part of this activity a detailed schedule for the FE integration and verification tasks has been incorporated in the IPS. An alternative approach, with simplified logistics, for the FE integration, where integration of cartridges is split up between EU (Band 7 and 9) and NA (Band 3 and 6), is also under study. A final choice will be made as part of the project rebaselining.

- **Amplitude Calibration Device**
  The efforts under the feasibility study for a new amplitude calibration device focussed on the production of a broadband, precision load. By the end of this reporting period a prototype was available to be delivered by RAL to IRAM for testing. In the mean time IRAM had prepared special test receivers at 3 mm and 0,7 mm to assess the load performance.

- **Water Vapour Radiometer**
  The correlation type prototype WVR developed and built by Cambridge became available for lab testing after solving the problem with too much cross-talk between channels in the RF front end. By the end of this reporting period both prototype WVRs, the Dicke-switched WVR built by Onsala Space Observatory and the correlation WVR built by Cambridge, had undergone the complete lab testing program. The test results are being evaluated and will be presented at a PDR which is scheduled for 4th to 5th May 2005.

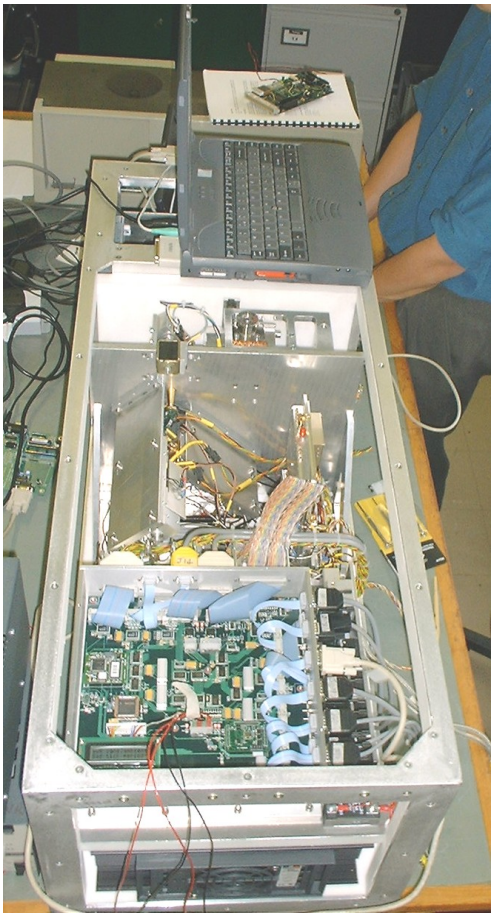

Figure 10: Correlation WVR with modified RF front end ready for testing.

Technical status / performance achieved

A problem has been encountered with the plastic windows used as RF feed-throughs in the cryostat. It has been noticed that after some time cracks occur in the plastic causing the window to fail in the end. This problem has been traced back to a manufacturing error when moulding the parts. The involved parts will be made again using the correct moulding procedure.

Highest level technical and managerial risks and concerns

- **Band 9 1st Local Oscillator**
  The absence of cold multipliers, meeting requirements, for the Band 9 cartridge has become a serious problem. These components are on the critical path for completing the first pre-production Band 9 cartridge. A prototype system was delivered, but alternate paths toward a final, complete solution will take several months to develop.

- **WVR field testing**
  With the current baseline plan for field testing of prototype WVRs, any further delay in this testing also has negative impact on delivery milestones of pre-production WVRs.

  It is proposed to mitigate this delay by abandoning the baseline plan. This baseline plan assuming to start detailed design and pre-production phases only after completion of prototype field testing. Instead after completion of comparative lab testing and possibly the detailed design phase should directly start. The WVR interferometric test can be done later once the ATF interferometer becomes available, parallel with the WVR detailed design phase.

  A schedule for the recovery plan that can be compared with the baseline plan has been prepared and is available as part of the IPS. A final decision on how to proceed has been postponed due to the current project rebaselining process. The final choice will be made as part of this rebaselining process.

Planned activities for next period

- Completion of assembly, verification and delivery of first cartridge pre-production units, Bands 3/6/7/9, will be a major activity in the forthcoming months. Delivery of these cartridges is scheduled for early 2005.

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

- An early test of the Band 6 cartridge #1 in the first cryostat is planned. This will use the test facilities of the Band 6 cartridge test system.

- Contracts will be issued for the major handling equipment for the Front-End assemblies, namely a Tilt Table and Cartridge Loader.

- The comparative test plan for the prototype Water Vapour radiometers, correlation type versus Dicke-switched, will be completed by Onsala Space Observatory and Cambridge Astrophysics. Afterwards a PDR will be held to assess the test results and radiometer designs.

- Completion of the feasibility study on the new multi-load amplitude calibration device. The objective of this study is to assess the feasibility of the new calibration scheme based on prototyping of critical hardware and numerical design analysis.

- The delayed (due to the project rebaselining activity) detailed Front-End integration and test plan will be completed.

Status Level 2 Milestones

ALMA Project Level 2 Milestones

IPT	Milestone #	WBS	Activity Description	Status	Baseline Date	Forecast	Responsibility
Front End	8755	1.04.085.0680	Cartridge bodies for first receiver delivered (Project MS)	Complete	01-Jan-04	12-Nov-04	ESO
Front End	8825	1.04.105.0800	Deliver Prototype DC Bias Electronics for Cartridge #1	Complete	01-Jan-04	15-Dec-04	NRAO
Front End	8860	1.04.100.0782	Deliver Software for DC Support Electronics to Users	Complete	01-Jan-04	03-Feb-05	NRAO
Front End	8895	1.04.258.1101	Deliver LO WCA for Cartridge #1	Complete	01-Jan-04	03-Feb-05	NRAO
Front End	8790	1.04.095.0760	Windows (6,7,& 9) set for FE #8 Delivered (to RAL)	Complete	01-Jul-04	17-Feb-05	ESO
Front End	8995	1.04.075.0640	All FE Contracts / Agreements in place - FE #1 - #8	Planned	01-Apr-03	01-Mar-05	ESO & NRAO
Front End	8820	1.04.100.0782	Freeze the Design of the DC Support Electronics	Planned	01-Oct-03	01-Mar-05	NRAO
Front End	8945	1.04.165.1326	6.1 Band 6 Cartridge #1 delivered	Planned	01-Oct-04	04-Apr-05	NRAO
Front End	8775	1.04.095.0740	Band 3 Mirrors for Cryostat #1 Delivered to FEIC	Planned	01-Jan-04	13-Apr-05	ESO
Front End	8910	1.04.105.0820	Deliver the IF Switch / Processor - FE #1	Planned	01-Oct-04	23-May-05	NRAO
Front End	8935	1.04.145.1323	3.1 Deliver Band 3 Cartridge #1 to FEIC	Planned	01-Oct-04	26-May-05	NRAO
Front End	8990	1.04.075.0640	FE Sub-System Delta PDR Passed	Planned	01-Sep-03	27-May-05	ESO & NRAO
Front End	8955	1.04.175.1420	Band 7 Cartridge unit #1 delivered to Integration Centre (Project MS)	Planned	01-Oct-04	15-Jun-05	ESO
Front End	8965	1.04.195.1460	9.1 Band 9 Cartridge Unit #1 Delivered to FEIC (Project MS)	Planned	01-Oct-04	06-Jul-05	ESO
Front End	8920	1.04.100.0780	Freeze the Design of the FE Chassis	Planned	01-Oct-03	09-Aug-05	NRAO
Front End	8925	1.04.105.1660	Deliver the FE Chassis for FE #1	Planned	01-Jan-04	21-Sep-05	NRAO
Front End	8760	1.04.085.0680	Cartridge Bodies for FE #8 Delivered (Project MS)	Planned	01-Jan-04	18-Oct-05	ESO
Front End	8830	1.04.105.0800	Deliver DC Bias Electronics for FE #8 (set of 4)	Planned	01-Jul-04	19-Oct-05	NRAO
Front End		1.04.100.0780	Deliver Main FE M&C Software Req. to Computing IPT	Planned	01-Jan-04	20-Oct-05	NRAO
Front End	8845	1.04.100.0780	Freeze Hardware Design M&C Circuit	Planned	01-Oct-03	27-Jan-06	NRAO
Front End	8850	1.04.105.0840	Deliver the M&C Module for Front-End #1 to FEIC	Planned	01-Mar-04	27-Jan-06	NRAO
Front End	8855	1.04.105.0840	Deliver the M & CI Module for Front-End #8 to FEIC	Planned	01-Sep-04	05-Jul-06	NRAO
Front End	8922	1.04.100.0780	Freeze FE Design	Planned	01-Jan-04	07-Nov-06	ESO & NRAO

Back-End IPT

Planned versus actual accomplishments over the period

- Continue documentation for pre-production modules.
- The rescheduling exercise shows a tight production schedule to be completed by 2009 when NA Back-End IPT funding will end. The budgeting exercise shows an overage of about 2%, at least in part driven by scope increases.
- Verification test plans were completed except for European deliverables and LO Photonics.
- Procurement for pre-production modules was continued where practicable.
- Re-design of TP digitizer for IF processor was completed and is being prepared for fabrication.
- Verification tests of prototypes are being performed and results loaded to EDM. Tests uncovered intermittent problems with DTS operation; specifically, intermittent clock problems on the formatter and deformatter circuit boards.
- A new BE System Technical Requirements and allocation of requirements within the BE design has been prepared but needs further SE input.
- Refined digitizer setup procedure. Performed acceptance tests of Phobos demux chips for production.
- Performed first static tests of Vega 2 sampler final design with industrial tester. Performance comparison of Vega 1 and Vega 2 samplers show that Vega 2 is a good design.
- Prepared detailed Statement of Work for industrial assembly of pre-production Digitizers (for first 8 antennas), and selected one vendor as the result of a request for tender.
- New Digitizer Test Bench (DTE) operational for real time DG adjustments and performance diagnosis (statistics, Allan variance, etc.).
- ALMA memo #510 "The ALMA Digitizer (DG) Demultiplexer: Design, Performances in DG Assembly and Production Acceptance Tests" was released.
- Delivered second laser synthesizer and prototype master laser to Prototype System Integration, but delivery of preliminary version of line length corrector LRU (Line Replaceable Units) delayed to support holography tests at ATF.
- Continued release of pre-production RAL WR-10 and WR-08 photomixers.
- Continued update of design for LO Reference Receiver.
- Continued cooperative effort with RAL and UKC (University of Kent, Canterbury) to identify polarization effect on phase and specifications for an optical amplifier, but effort to begin LO Backup Plan study has not yet been approved by management.
- Delivery of first versions of integrated IF processors to prototype SI delayed by vendor.
- Completing external ICDs (between Photonics LO, DTS fiber optic components, frequency standard, AOS TB fiber plan and Computer, between BE and Site AOS TB, BE fiber plan and Site,

Photonics LO and FE, and AOS TB fiber plan and Computer) delayed by effort given to rebaselining exercise.

- The preparation of a preliminary subsystem level optical power budget to clarify interface signal levels, optical amplifier requirements, and optical power safety requirement shows that EDFA amplifiers for DTS system can be eliminated.
- The Fiber Optic Cable and Management design review was conducted at the ESO Headquarters in February 2005, and a report produced.
- Continued rebaselining work.

Technical status and technical performance results achieved over the period

- The integrated "1/2" transponder for the Digital Transmissions System (DTS) was tested successfully on a revised formatter board. However, both formatter and deformatter circuit boards must be revised to correct intermittent clock problems. The clock problems are unrelated to the ½ transponder.
- The vendor for the integrated IF (Intermediate Frequency) processor now plans to deliver 4 prototype modules in Q1 2005. Effort on a second version of the prototype must commence immediately after testing to further improve gain flatness, address packaging issues, remove step attenuators (which have been moved to FE), and address other minor design issues.
- A rework of the Central Reference Generator is expected to provide an improvement in phase noise performance for the microwave reference (CVR) input to the laser synthesizer.
- A design revision for the Line Length Corrector is expected to reduce acoustic sensitivity which caused the current module design to jump fringes. Efforts continue to contract with UKC (University of Kent, Canterbury) for conducting analyses of alternate Photonics LO schemes in the event the current design is shown to be unable to meet requirements.
- An end-to-end LO analysis is required to confirm the current LO design and to identify requirements for the CVR.

Highest level technical and managerial risks and concerns

- To meet the current requirement to deliver modules for the first two antennas by *[TBD]*, the BE IPT plans to provide pre-production modules which may require revision for the full production run. The pre-production modules will be produced in parallel with completion and testing of prototype modules. The existing prototypes and the pre-production modules will perform adequately for science operations.
- UB (University of Bordeaux) has performed satisfactory tests of the prototype digitizer. If performance problems are encountered with the production version of the digitizer, the prototype sampler chip could serve as backup.

- System level IF processor specifications for gain flatness have changed since the release of a contract for construction of prototype integrated modules. An order of pre-production modules will permit a second cycle of prototyping and testing before the final production module is procured. The existing prototypes and the 1st set of integrated prototypes are expected to work adequately for initial testing and science operations.
- Polarization mode dispersion and acoustic sensitivity problems with components in the Photonics LO design could result in phase noise performance less than requirements. A study to analyze and compare the performance of the current design with other schemes, such as an amplitude-modulated single frequency scheme, has been requested. Prototypes and pre-production modules for the first two antennas may not meet specification for the highest planned frequency and the most distant antenna, but will be adequate for initial testing and science operations at the Array Operations Site (AOS).
- An e2e LO analysis is required to confirm current design.
- NA Back-End IPT funding is scheduled to end 2009.
- There are currently no resources provided for integrating ACA design.

Planned activities for next period (March – July 2005)

- Release revised plan for IPT-level approved documentation suitable for CDR and production.
- Complete or finalize to the possible extent verification test plans for European deliverables and LO Photonics.
- Continue procurement for pre-production modules where practicable; complete Statement of Work and specification for antenna racks.
- Complete construction of TP digitizer re-design for IF processor.
- Continue verification tests of prototypes for prototype SI.
- Complete BE System Technical Requirements and allocation of requirements within the BE design.
- Complete procurement of antenna fiber cable wrap prototype and begin tests.
- Deliver line length corrector LRU (line replaceable units) to prototype SI.
- Complete update of design for LO Reference Receiver, Central Reference Generator and Distributor and commence testing.
- Commence Photonics LO Backup Plan study if proof of concept for existing Photonics LO design not performed satisfactorily by 31st March.
- Deliver first versions of integrated IF processors to prototype SI.
- Complete external ICDs.
- Finalize fiber optic cable choice and fiber optic cable management plan for AOS. Conduct review of fiber optic cable management plan for cable inside the AOS TB (Technical Building).

- Complete rebaselining work.
- Complete re-work of DTS formatter and deformatter to correct intermittent clock problems.
- Receive a transportation plan and delivery schedule from Management IPT. Use the information to update Production Plan and PMS (Program Management Schedule). This is carried over from previous report because no plan and solid delivery schedule have yet been received from Management.
- Begin planning for incorporating ACA in BE production plans.
- Complete to the possible extent the delivery of 1st 4 Vega 2 pre-production sampler chips.
- Clarify with ST Microelectronics process dispersion issues for Vega 2 industrial production
- Conduct DTS system tests to the possible extent.
- Complete CAN bus specification in cooperation with other IPTs.
- Complete RFI analysis.
- Commence e2e LO analysis.
- Prepare Statement of Work and Specification for pre-production integrated IF Downconverters and initiate procurement.

Milestone Summary

ALMA Project Level 2 Milestones

IPT	Milestone #	WBS	Activity Description	Status	Baseline Date	Forecast	Responsibility
Back End	9105	1.05.262	Install BE Hardware on Two ALMA Prototype Antennas at the ATF	Planned	1-May-04	4-May-06	ESO & NRAO
Back End	9122	1.05.305	Deliver Back End Assembly, Test, & Verification Plan	Planned	30-Nov-04	30-Nov-05	ESO & NRAO
Back End	9117	1.05.302.3810	End-to-End LO test (Prototype Photonic LO)	Planned	31-Dec-04	1-Mar-05	NRAO
Back End	9120	1.05.260.0055	All NA BE Production Contracts Placed	Planned	1-Jan-05	5-Mar-07	NRAO

Correlator IPT

Achievements

The goals for the period October 2004 to February 2005 were:

1. Continue production printed circuit board bench testing and have 100% of the boards for the first quadrant verified, with the exception of the TFB, Final Adder Card, and Data Port Interface Card;
2. For the Final Adder Card, make the design and SOW 90% complete;
3. Receive 50% of the signal cables for the first quadrant and perform preliminary testing;
4. Verify the TFB algorithms in the pre-prototype card;

5. Begin testing of the first full prototype TFB card;
6. Hold the PDR for the TFB card;
7. Hire an engineer to work first at the NTC with the intent of moving to Chile in 2006 with the first quadrant delivery.

The status of these goals is as follows:

1. Completed. In addition, 65% of the boards for the second quadrant have been tested. We have also received but not fully tested about 20% of the third quadrant boards.
2. Completed. The SOW is ready to issue.
3. Completed. 100% of the cables are in hand and testing so far indicates no problems. The contractor has been authorized to proceed with the remainder of the cables.
4. Completed.
5. Completed.
6. Completed.
7. Completed. Alejandro Saez began work in January 2005.

In addition, the following tasks have been accomplished:

1. Two Station Racks and two Correlator Racks have been populated and partially tested. The other 4 racks of the first quadrant have been fully assembled.
2. The power wiring was modified to eliminate the distribution rack, saving floor space.
3. The last shipment of custom correlator chips was received.
4. The clock distribution system design was completed, and the first clock distribution printed circuit board was designed, fabricated, and successfully tested.
5. A DTS Simulator card was fabricated and tested.
6. An RFI survey of the NTC laboratory was conducted which included measurements of the first quadrant approximately 1/3 populated.
7. The design of the revised Data Port Interface card was completed, and cards were successfully fabricated and tested.
8. The designs of the Final Adder, revised Quadrant Control Card, and new Power Control Card were completed.
9. The prototype full TFB card with FPGA devices was tested including a spectral line detection test.
10. We have begun to gather the information required for migration of the TFB FPGA design to Hard Copy devices. A study has started to optimize all resources available in the TFB FPGAs.

Status and Results

Procurement

Essentially all the hardware is being manufactured commercially. Contracts are in place for all parts of the first quadrant for all except the following:

Tunable Filter Bank cards: prototype cards fabricated and tests ongoing; PDR held 18th to 20th October 2004 and TFB Review meeting scheduled by mid April.
Final Adder Card, revised Quadrant Control Card, and Power Control Card.

Delivery and checkout

With the exception of the items listed above, we have received a total of 1220 boards: 100% of the printed circuit boards needed for the first quadrant, 72% of the boards needed for the second quadrant, 21% of the third quadrant, and 1.5% of the fourth quadrant. Almost all of these have successfully passed the initial set of tests in s.

The following minor problem has been resolved:

- There were a few instances of unsoldered pins. This quality control issue has been addressed by the board assembler, and the error rate has dropped to near zero.

Board delivery and checkout is in a very satisfactory state. All the custom correlator chips have been delivered.

Tunable Filter Bank (TFB) development

The VHDL software implemented in the TFB digital filters includes now all functions required for ALMA and a study to optimize the logical resources available in the FPGAs has begun.

A complete list and description of the tests to be performed with the Test Fixture for the filter cards has been established. The tests are intended to check communication with the Test Fixture, the signal distribution in the card components, or to perform a card spectral analysis and dynamic tests. Software development for a number of all listed tests has progressed well and continued together with hardware verifications during the period.

For the pre-prototype TFB card (3 FPGAs only per card) we have successfully verified (1) complete functionality and communication for the 3 delay chips on the card and (2) communication with FPGA registers through the CPLD2.

Routing of the full prototype TFB card with all 16 FPGAs required for ALMA was rather quickly concluded. Three cards have been fabricated and the first card was fully populated and delivered in mid December. After some debugging, all basic tests (supply, clock, 1msec strobe, JTAG chain) were shown to be good and the card was well 'detected' by the Test Fixture (see Figure 11). Tests completed include demonstrating successful filtering and the expected detection of a spectral line which can be moved around within the band.

The documentation required for the TFB PDR (18th to 20th October) was assembled and posted, together with the presentation talks, to ALMA EDM. Recommendations provided by the panel committee

have been translated into a list of actions; some of them have already been closed. The PDR meeting was followed by an ad-hoc software meeting to evaluate the specific tasks required for operation of the TFB cards. Planning is underway for a CDR.

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 and DTS receiver card schedules. 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 have only one of the four station racks completely populated and do the remaining integration later in Chile. This would allow use of the first four antennas as soon as they are ready with all four IF baseband pairs. With the revised schedule for the AOS building giving us a likely disassembly date of July 2006, the TFB cards will probably not be an issue. The Back-End IPT would have to produce only 4 (+ 1) more receiver boards than planned in order to populate one entire station rack, and a CRE has been written for this purpose.

Planned activities for next period

The goals for the period March to May 2005 are:

1. Continue board testing in the background for the second and third quadrants as production boards are received;
2. Continue integrated testing of populated first quadrant racks, and perform the first end-to-end test;
3. Use DTS Simulator cards in integrated testing;
4. Receive and test the first Final Adder Card, revised Quadrant Control Card, and Power Control Card;
5. Continue Test Fixture and test display programming for TFB card testing;
6. Continue testing of first full prototype TFB card and populate and test two additional prototype TFB cards.
7. Prepare for TFB card CDR.

Milestone summary

The original construction plan for the correlator involved placing orders for most of the elements one quadrant at a time. This is the philosophy behind the official milestone table carried by the project, of which the last official update is Version 2003nov07a, even though many milestones have been accomplished since that date.

The new construction plan, including the TFB, involves placing essentially all the orders for everything up front and achieving substantial savings as a result. In addition, the implementation of the new ALMA Project Management Control System has been used in the generation of an entirely new schedule for the correlator. However, the milestones in the new schedule have not yet been officially adopted.

ALMA

It is somewhat difficult to relate the old milestones to current status, because the plans are different. Changing the procurement strategy also resulted in apparent delays of some old milestones while speeding up some activities and having little effect on the overall delivery schedule. The below table attempts to relate current status to the old milestones (milestones 92xx are level 2, milestone 60xxx are level 3).

Milestone	Description	Nov7a target	Revised target	Status	Comment
60403	All motherboards installed	15 Jul 04	31 Mar 05	Done 9 Feb 05	6 weeks early
9260	Begin board testing for second quadrant	01 Mar 05	01 Apr 05	Done 12 Aug 04	7 months early
9285	Begin board testing for third quadrant	01 Mar 06	01 Mar 06	Done 3 Dec 04	18 months early
60404	All 1st quadrant PCBs assembled	30 Sep 04	29 Oct 04	Done 14 Nov 04	6 week delay; exceptions are redesigned Final Adder, TFB, QCC
60405	1st quadrant end-to-end testing begins	30 Sep 04	31 May 05		8 month delay
60501	1st quadrant ready to ship to Chile	30 Sep 05	05 Jun 06		8 month delay

Bottom line: the correlator is on track to have the first quadrant ready to go to Chile by the end of June 2006.

By the time the first quadrant is delivered, substantial progress will have been made toward the construction of quadrant two, and most of the hardware for quadrants three and four will have been delivered. Final installation will be complete by October 2008.

Since we expect to meet the schedule for delivery, no recovery plan is required.

Recent photographs

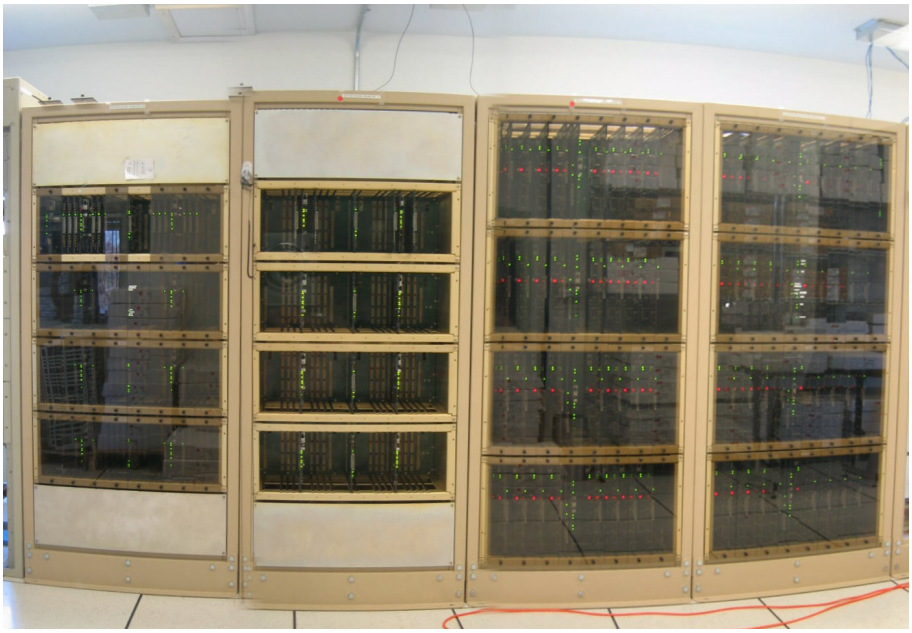

Figure 11: Correlator room with four populated racks.

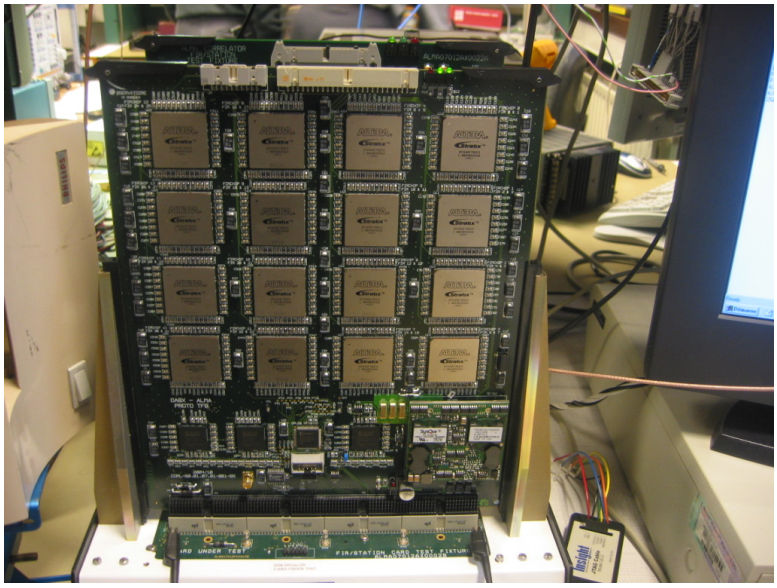

Figure 12: Full prototype TFB card with all 16 large FPGAs on Test Fixture.

Computing IPT

Accomplishments

The status of the level 2 milestones planned for the current period and next are as follows:

Milestone	Original	Actual
Release 2 check-in (R2)	2004-10-01	2004-10-01
Integration Release 2 (IR2)	2004-12-01	2004-12-20
Release R2.1 check-in (R2)	2005-03-31	
Critical Design Review #3 (CDR3)	2005-05-01	

The delay in the release was caused by the integration process (which started on 1st October) being more difficult than anticipated largely due to insufficient pre-release testing by individual subsystems. We will introduce more rigorous checks at the monthly integrations to provide earlier feedback to subsystems about the adequacy of their testing and procedures. We have also, and are currently procuring, a Standard Test Environment (STE) to provide for identical hardware integration platforms between Socorro and Garching.

Rebaselining work was a significant activity in this period, including the submission to the JAO of two statements of work with associated budgets and ancillary supporting information.

Supported restarted antenna testing at the ATF.

A user test of the Offline (AIPS++) subsystem was held, with an emphasis on mosaicing. *http://almasw.hq.eso.org/almasw/pub/Usertests/WebHome/UserTestReport.dec04.pdf*

A user test of the Pipeline heuristics was held, to test the calibration flagging heuristics. *http://almasw.hq.eso.org/almasw/pub/Usertests/WebHome/Test2report17Dec04.pdf*

The Executive subsystem held a test to check the functionalities delivered with R2: *http://almasw.hq.eso.org/almasw/bin/view/EXEC/PostR20Testing*

The Observing Preparation and Support subsystem had an external test of the ALMA Observing Tool. *http://almasw.hq.eso.org/almasw/pub/Usertests/WebHome/ALMA_ObsPrep_UT2_Report_31Jan05.pdf*

A user test of the Telescope Calibration subsystem was held to test the calibration engines delivered with R2 (with both simulated and Plateau du Bure data). The test report is in preparation.

All tests are considered to have been successful.

ALMA

The CIPT held an all-hands meeting in Europe. The format was a combination of plenary status sessions, with parallel working group meetings and tutorials. The meeting was considered to be very successful.

A COTS tool (DOORS) for management of CIPT requirements and features was selected and installed and the process of loading the CIPT planning into is complete and the process of regularly performing status updates against it is starting. This process is fully compatible with PMCS, indeed summary output information will be used by PMCS. This follows the requirements management plan which was finalized within the CIPT in this period.
http://almasw.hq.eso.org/almasw/pub/MNGPUB/WebHome/rqmts.mgt.plan.pdf

The ALMA Science Data Model, which is the fundamental data output of ALMA, advanced considerably. Work to automate the generation of language bindings from UML was concluded. Some inconsistencies in naming were fixed. The ALMA Project Data Model (APDM) was similarly updated.

The AMBSI-1 design was updated to accommodate obsolete parts. It is backwards compatible with previous designs. A design review for the AMBSI-2 design was held. Some design updates will be forthcoming. Long-lead items for AMBSI-1 & 2 were ordered after estimates on numbers required were obtained from the other IPTs.

Held a joint CIPT/AIVC meeting to clarify responsibilities for AIVC. Fundamentally no new requirements were discovered. Detailed notes/conclusions were distributed.

Management interaction with Japan to progress on secondment/hiring of Japanese provided staff to the CIPT/NA. Several staff will arrive in Socorro in the coming months.

The planning for the ACS 4.1 release was finalized.

Risks and Concerns

Scope risks:

- CDR2 estimates are that an additional 31 FTE-yrs (~15%) effort is needed to maintain PDR scope.
- Operations software needed by ALMA and logical CIPT activity but not in PDR scope or Construction budget (15 FTE-yrs). PDR scope affected by draft Operations plan. (10 FTE-yrs)
    - Resolution will occur as part of rebaselining.

Schedule risks (towards Early Science Operations):

- Chilean Computing Ops staff should be hired *soon* by Ops to be fully trained in Eu/NA by CIPT in time for start of significant activities in Chile.
    - Delay in start of activity in Chile provides some additional time to start this activity.
- Prototype System Integration (PSI): receiving attention but *late*. Reducing ATF test time will require more testing in Chile, which probably places this software on the critical path.

- Additional antenna testing campaign diverting key personnel from other tasks related to first fringes at the ATF.
    - Risk greatly ameliorated by decision to keep ATF functional until activity in Chile is significant.

Other concerns

- *Software process*. Integration problems must be resolved.
    - CIPT has release cycle to discover these problems, actions (including more use of monthly integrations) have been identified to resolve these issues.
- *Software test time*. Initial antenna delivery dates can't slip without consequence to the start date of early science operations. In particular there is a period of one year for commissioning with a 3 antenna interferometer, which is part of the present planning. This amount of time is needed in any event to produce tested software, which can be considered ready for early science.
    - Sufficient test time must be left in the schedule.
- *Impact of Japanese entry*. This is being discussed with the aim to come to a proposal for an integrated Computing IPT work. Attention is paid to the fact that there shall be no impact on bilateral milestones and to the fact that the Japanese team takes responsibility for their deliverables, which require a very steep computing staff increase in a compressed period of time.
    - Japanese are aggressively moving to fill positions in Eu/NA.

Planned activities for the next period

1. Check-in of software from all subsystems for R2.1, so release integration can start;
2. Rebaselining proposal finalized, pending senior management approval;
3. Installation of prototype Archive in Socorro;
4. Incorporation of up-to-date ASDM, including generated code framework, in Offline (AIPS++) and data capture contexts;
5. Routine status updates of requirements and features in DOORS;
6. An ACS 5.0 planning proposal will have been made;
7. Critical Design Review #3 meetings will have been held.

System Engineering and Integration IPT

Management

- **Rebaselining**
  Planning meeting held from 6th to 9th December at ESO in Garching: Christoph Haupt, Dick Sramek, Jeff Zivick and Rick Murowinski (via videoconference).

  Planning meeting held in Socorro with Dick Sramek, Christoph Haupt, Rich Grubb (Triad)

Completed SE&I work elements (WEs) rebaselining efforts. Details of staffing, scheduling and risks added to work element descriptions.

First draft of revised budget prepared and submitted. A more quantitative analysis of Chilean SI costs have resulted in a significant increase.

- **Staffing**
  SE&I ESO has hired new system engineer, Luitjens Popken. He is focusing on Front-End, Back-End and LO subsystem. A second new hire has been selected for system integration activities with an anticipated start date of April 2005.

  Stacy Oliver (SE&I NA), who has been responsible for the updating and control of ALMA electronic document management system (ALMAEDM), resigned from Systems Engineering.

  A replacement RF/microwave engineer has been hired for a combined system engineering and prototype system integration roles within the group.

  A photonic LO and a DTS system engineer are being considered to start in early 2005.

Engineering

SE has been heavily involved in supporting the JTEG activities attending meetings, providing technical analyses and participating in ATF testing. This JTEG support has restricted progress on Prototype System Integration activities.

Discussions to clarify the responsibilities and interfaces between system integration, commissioning and operation of ALMA have started, and are progressing well.

The only contact with Japan was on integrating ALMA-J components into the Product Tree. No further discussions were held with Japan on how the bilateral SE and ALMA-J SE will interface because priority was given to work on the existing bilateral issues and the rebaselining. However these discussions should continue once the rebaselining process is done.

- **Configuration Control and Documentation Management**
  Eight Interface Control Documents (ICDs) and three other ALMA documents were approved and released. In addition four Change Requests (CREs) were technically approved.

  The ALMA Configuration Control Board (CCB) responsibilities were expanded to include review and approval for Request for Waiver (RFWs) and budget change requests which will now be handled as part of the change request process.

The ALMAEDM documentation server is planned to move to Chile in April 2005. It is also planned to have most of the documentation management handed over to local JAO staff in Chile by mid 2005.

Stacy Oliver (ALMAEDM specialist, resigned) spent one week at ESO in December to train Nathalie Thebaud and Elena Zuffanelli who have temporarily taken over the ALMAEDM work.

A draft of requirements for selection of a Product Data Management Systems (PDMS) and a Computerized Maintenance Management System (CMMS) has been completed. These two systems are needed in Chile by the start of systems integration to manage and track the status of each Configuration Item delivered to and installed in the ALMA system.

- **Requirements and ICDs**
  Progress was made on the identification, prioritization and approval of the ICDs and of the top level requirements. New ICDs were identified between COMP and FEND, COMP and BEND, SITE and COMP. 2 ICDs between SITE and the ACA have been added to the list. The number of ICDs will probably increase further, in large part because the equipment provided by Japan will bring some new interfaces to the project.

  Requirements for ALMA equipment identification and labeling standards have been written and approved.

  SE&I has driven resolution of the issue of metric dimensioning and component design and has prepared an ALMA Metric Policy document to provide guidance to the IPTs.

  Following is the project-wide specification status. Note that although most specifications are complete, many of the important high-level specifications are not among them. Bringing the specification tree to closure remains a very high priority.

Project Wide Specification status	28-Feb-2005	30-Sep-2004
Approved	25	19
Submitted	8	5
Draft	1	1
Not started	0	1
Total	**34**	**26**
Completion status (weighted)	**90%**	**87%**

The status of the ALMA external ICDs was reviewed and the end of February, 2005 status is shown in the table below.

ICD status	28-Feb-2005	30-Sep-2004
Approved	23	14
Submitted	12	13
Draft	8	10
not started	9	6
Total	**52**	**43**
Completion status	**65%**	**60%**

- **Design and Analysis**
  SE&I IPT participated and/or chaired the following technical meetings: Cryostat CDR, FEIC meeting at RAL, Fiber management meeting at JBO, External AOS Fiber System CDR at ESO and Tunable Filter Bank PDR at Bordeaux.
  The requirements management software DOORS has been installed at ESO. To date, the ALMA Science requirements and the ALMA System Technical requirements have been entered into the database. Completing the database entry of all IPT technical requirements is anticipated to be a time-consuming job for which ESO plans to hire a student.
  The AOS electrical power requirements survey has been nearly finalized. Comments are awaited from Antenna and Site IPTs. The document details each subsystem's requirements for power under normal operation and during power outage conditions which include requirements for UPS and long duration emergency generator power.
  The ALMA Electromagnetic Compatibility (EMC) analysis has started. A draft EMC plan has been prepared summarizing the activities which need to be performed. A first version of the ALMA frequency plan has also been prepared.
  Completed ALMA Video Surveillance System requirements document and working with suppliers to obtain a rough order of magnitude pricing proposal for budget planning.
  Completed Computer IPT Reliability Analysis and submitted to ALMAEDM for IPT approval.

Product Assurance

- **Reliability Analysis**
  The bottom-up analysis of system reliability made good progress the past quarter. Interim reliability analysis reports have been issued for the Correlator and Front-End subsystems. The final Computing IPT reliability analysis report was issued. The Back-End interim analysis report and the final Correlator analysis report will be issued in the next reporting period.

Reliability Analysis Status December 2004			
Subsystem Tasks	Total	Completed	Percent Complete
Correlator	17	16	94 %
Back-End	25	20	80 %
Front-End	34	30	88 %
Computing	5	5	100 %
LO	6	0	0 %

The reliability analyses for all subsystems are dependent on the completion of the final hardware designs. Currently, the subsystem reliability analysis is proceeding on schedule to complete in Q1 2005.

- **Quality Assurance**
  QA activities during this period were the review of multiple BE IPT ICDs, Statements of Work and technical specification documents and participation in the Cryostat and External Fiber Subsystem CDRs.

Prototype System Integration

Dick Sramek is leading the P-SI effort previously lead by Larry D'Addario. The P-SI effort is placing more emphasis on requiring the hardware and software IPT engineers to test and verify their modules and sub-systems prior to delivery to P-SI. A comprehensive P-SI test plan is near completion and has benefited from the contributions of Back-End and Computing IPTs.

- **Current Activities**
  P-SI Tucson is currently testing LO reference signals and has completed two test reports: ALMA-80.12.03.00-005-A System Integration Phase Noise Measurements and ALMA-80.12.03.00-007-A System Integration Phase Noise mm-wave Measurements.

  PS-I Tucson has also conducted phase drift versus temperature testing.

  PS-I Socorro has spent much time writing and debugging Python scripts for system testing.

  DTS link stability testing in progress by the Back-End IPT at the P-SI Socorro facility.

- **Issues/Concerns**
  Prototype system integration efforts continue to be hindered due to subsystem equipment being delivered late and/or not fully meeting the form, fit and function requirements for a true prototype. Equipment not ready for integration is not accepted and is returned to the IPTs.

Current staffing levels of the P-SI team in Socorro are insufficient to complete required minimum prototype system integration testing. The staffing level should be increased to perform all needed work.

Current budget for Socorro P-SI testing of nine months is too short to complete required minimum prototype system integration testing and maximize the opportunity provided for additional software development/integration testing. The integration testing period should be increased to perform all needed work.

The Socorro P-SI test environment at the ATF serves as a test bed for software development until this work can be taken up in Chile.

It is proposed, in the revised budget, to extend prototype system integration and testing until the work can continue at the OSF in Chile.

All prototype hardware was scheduled to be delivered to System Integration by January 2004. Only the prototype correlator was ready on time. Most hardware was delivered three to six months late. By end of September most hardware was delivered (missing were the Laser Synthesizer and Line Length Corrector LLC modules). Many were only in a preliminary, not prototype form, when delivered, and some modules did not meet performance specifications.

Chilean System Integration Planning

A face-to-face meeting between Christoph Haupt and Rick Murowinski took place in Garching. It was agreed that in addition to the detailed bottom-up plan currently being developed, two additional documents will be prepared. One is the Chile system integration plan describing the main steps and which shall also provide information about the interfaces to the IPTs delivering equipment and the science IPT doing system commissioning and verification, acceptance criteria, test equipment needed. The other document should provide more details about the integration procedures.

The detailed plan Rick Murowinski is working on progressed significantly in the last quarter and is incorporated in the IPS.

Subsystem-level Statements of Work, which are now in the process of being prepared at all development IPTs, will support this. Discussions with the IPTs are ongoing to define better the tasks and the interface between system integration, commissioning, science verification and operation.

Critical Areas

Progress was made on the preparation and approval of ICDs. However there are still some ICDs only available in draft form and some even not started. It has to be pointed out that the SE&I IPT is not

writing these ICDs but is rather managing this process. The late delivery of these documents will not delay the overall project.

Many high-level requirement documents, including the 'ALMA Scientific Requirements: Specifications and Requirements', have not reached a stage of being formally approved.

A database needs to be established to provide links between the product documentation and the specific Configuration Items. This is extremely important for maintenance and needs to be in place prior to the start of the system integration phase.

Prototype integration is running late mainly because equipment is arriving late or is not fully functional. Progress has been achieved but some equipment is not available or not meeting specification.

System engineering remains understaffed. An effort is made to increase the staffing and recruitment is in progress.

The impact of Japan on SE&I entering the project needs to be assessed and planned.

System error budgets currently do not cover all aspects of ALMA and need to be further developed and completed.

Science IPT

Planned versus actual accomplishments over the period

During the period, Science IPT has provided the review panel chair, Robert Laing, for the Tunable Filter Bank PDR; Robert also served on the Fiber Management CDR. Further revisions of the ALMA Scientific Specifications and Requirements (ALMA-90.00.00.00-001-A-SPE) were written by Wootten; the status of this revision is pending CCB Review.

The CCB approved the antenna move plan and the plan for the largest 64 antenna configuration. During the December-January period, the Science IPT has focused on the ALMA rebaselining effort, supporting prototype antenna testing at the ATF, the plan for assembly, integration, verification and commissioning of ALMA in Chile and, at the end of the period, providing support for the ASAC as it prepared to address its Charge from the Board. The plan for transition from site characterization activities to site monitoring activities during the ALMA Operations phase was put in place.

ALMA

Scientific Advisory Committees

As planned, the Science IPT facilitated the meeting of the ALMA Scientific Advisory Committee as it met in Charlottesville during September 2004 and in Garching during February 2005. The Science IPT provided support to the ASAC as it responded to its Charges from the Board. The IPT distributed the September report to other IPT leads in the project. Additionally, the Science IPT planned to the European ALMA Science Advisory Committee during its meeting in Garching on 23rd September 2004. Advice on ALMA Regional Centers and Early Operations was provided to the project based on the input of the community via this meeting. This was followed on 26th October 2005 by an ESO Scientific and Technical Committee discussion of the ARC. Wilson and Wootten attended the Board meetings in Santiago from 29th October to 6th November. An ARC meeting was held in Garching on 4th February 2005 to discuss the Expressions of Intent for the European nodes to the ARC in Garching. The ANASAC discussed talks and handouts for the Town Meeting at the 205th AAS meeting. At the meeting, Min Su Yun, chairman of the ANASAC, presented the ALMA Science talk. Under its Terms of Reference, terms of ANASAC members expired at the end of February. Plans for rotation of members were developed, a memo written detailing the selection procedure, and new members joined the committee.

Milestones

The below table gives the status of Level 2 milestones due during the current quarter and the next quarter.

Milestone	Level	Title	Date	Status
9818	2	ICD between Science and Site Approved	2004-Nov 30	Revised 2005 Jan 15
9835	2	Report WVR strategy / implementation / operations	2004-Sep-30	Modified; ALMA Memos 515 and 517.
Being assigned	2	Redesign configuration for 50-60 antennas	2005-Aug-30	In Progress

Note that Milestone 9835 in its original form depended upon tests of the WVR at the ATF. In the currently understood schedule, that has slipped to April 2007. Therefore we issued ALMA Memos No. 515 and 517 on the WVR strategy. Given the weather patterns at the ATF it is unlikely that WVR field testing can now be completed before winter 2006/7. As reported in June 2003, the baseline at the ATF is likely to be too short for atmospheric phase correction demonstrations; the field testing is mainly to demonstrate operation of the instrument.

ALMA

Technical status and technical performance results achieved

Calibration

In early October, an updated and expanded version of the Calibration Plan was produced under the guidance of the Calibration Group leader, Jeff Mangum. Under the impact of support for the prototype testing at the ATF, the Calibration Group's efforts progressed slowly. A feasibility study continues under the FE IPT for the multiple load amplitude calibration device described in ALMA Memo No. 461. A hot load was developed at and is under test at IRAM. Initial reports of measurements of a simpler, fallback amplitude calibration device utilizing a semi-transparent vane in Madrid have suggested that it may be suitable for ALMA. A final report is expected in March. Plans have been developed to perform astronomical tests of a semitransparent vane amplitude calibration device at the ATF in 2005.

Holdaway, Stirling, Richer and Hills continue to refine their grid of atmospheric models with which to model WVR performance in a study to determine the most effective way to combine fast switching and WVR correction of atmospheric phase perturbation, publishing ALMA Memos No. 515 and 517.

Commisioning and Science Verification

A plan incorporating schedule and resources was developed, based on the revised version of the Science Commissioning (CS) Plan presented at the ALMA Community Day week in Garching, on 24th September and to the ASAC on 27th September. A CS team has been formed, comprised of Laing, Emerson, Chandler, Lucas, Mangum, Shepherd, Wilson, Wootten, Saito, Morita and Kawabe. In discussions with the PMCS team, a plan for this phase of ALMA has been laid out in detail. By the end of November, a plan had been received from the Project Engineer and discussions on merging the two plans had begun.

To accomplish this goal, the Science IPT sponsored a meeting of its personnel along with those from System Engineering and Computing IPTs and the Operations Group at the AOC in Socorro 13th to 15th January 2005. The meeting was attended by Project Manager Tony Beasley and Project Engineer Rick Murowinski.

As a result of the meeting, several action items were delegated and a more complete version of the plan for assembly, integration, verification and commissioning of ALMA in Chile was developed. Plans for activities at the prototype interferometer at the ATF were also further developed.

Configuration, Antennas

The plan for calibration of ALMA baselines, a complex process for an array in which several elements move every few days was published as ALMA Memo No. 503 after review by several referees. The plan is also being refined in such a way as to ease the specifications on the fiber, in discussions with Shillue.

ALMA

The final two documents of the plan for the configuration of the 64 element ALMA were approved - the *Array Reconfiguration Sequence* and the *Long Baseline (Y+) Array Configuration Specifications and Requirements*. As ALMA approaches the end of the antenna procurement phase, it has become clear that one outcome of the rebaselining process may be an array of fewer than 64 antennas. Accordingly, a mitigation plan was developed to produce a configuration appropriate for 50 antennas. Work on this plan has begun, with a configuration expected by the end of summer 2005.

Site Characterization

Simon Radford left for another position at the beginning of November. Wilson and Wootten met with Nyman in San Pedro to develop a plan to deal with his loss, involving a gradual descope of characterization activities and phasing into operations period monitoring. It was decided to maintain the record, now a continuous ten years, without introducing new equipment. Monitoring of site conditions continues, with monthly posting of data to the ALMA website. Particular focus has turned to atmospheric characterization data needed during operation of the array. Radford left unfinished the definition of the instrumentation needed; this is now being finished by the Cambridge group. The preliminary document is available in the Science IPT documents area of ALMAEDM and has been provided to members of other IPTs for comment; it will be submitted in March 2005.

Lars-Ake Nyman continues to lead the site characterization group part time. Roberto Rivera spends his weekdays at the OSF with periodic maintenance visits to the instruments near the future AOS. An assistant, Jorge Diaz, was hired to accompany Rivera on these visits in conformance with site safety rules. Data from the NA instruments is now processed and posted by Mark Holdaway in Tucson. With the development of the ancillary instrumentation plan for monitoring of site weather conditions during the operations phase, plans have been detailed for the transition.

Science Requirements

Papers detailing how ALMA would achieve its Level One Science Requirements, after the project document awaiting approval, were given at the DUSTY04 Meeting in Paris; they have been published in ESA-SP577 “The Dusty and Molecular Universe”.

Organization, interaction with other IPTs

The Science IPT has worked closely with the SE&I IPT members to define the activities and milestones during the prototype integration at the ATF and subsequent ALMA integration in Chile. Wootten and Wilson attended a meeting on Assembly Integration and Verification sponsored by the Science IPT in Socorro from 14th to 15th January 2005. Mangum and Emerson have spent most of their time this period working with the prototype antenna testing at the ATF.

Meetings, Outreach and Public Education

From 4th to 8th October 2004 the "Cool Universe: Observing Cosmic Dawn" conference was held in Valparaiso, Chile. The emphasis of the conference was to introduce ALMA science to the Chilean astronomical community. The conference included an number of 1 hour review talks on topics ranging from the CMB and cosmic reionization, to the ISM and star formation, plus numerous short contributions.

ALMA

The conference was well attended (about 100 participants), with the majority coming from the Chilean astronomical community, including good representation from CTIO, ESO, and the Chilean universities. Beasley represented ALMA; Wilson, Beasley and Wootten wrote a paper, '*Status of the ALMA Large Millimeter Array*', for the Proceedings.

More than 230 potential ALMA and Herschel users gathered in Paris for the Dusty and Molecular Universe Conference, which focused on the science the community expects to reap from ALMA and Herschel. Paul van den Bout spoke on the origins of ALMA, and Carlos de Breuck and John Richer presented the top level ALMA science requirements from the newly approved Project Plan v2. A number of reviews of ALMA science capabilities were also given. The Proceedings of the conference have already appeared.

Wilson attended the RadioNet directors meeting at Jodrell Bank on 16th and 17th November. Later he gave an ALMA lecture at the IRAM interferometry school, for which he also sat on the scientific organizing committee. In December, he attended the Herschel preparation meeting and the start of the EU program 'The Molecular Universe.' Wootten worked with van den Bout and Hibbard on defining the North American ALMA Science Center, delineating web content to introduce it to the community. He gave a presentation on ALMA and the NAASC at Johns Hopkins University on 1st February.

An ALMA Town Meeting was held on 11th January 2005 (Tuesday) during the 205th AAS Meeting held in San Diego, CA. Wilson also attended, after a period in Tucson for discussions with ALMA personnel. The meeting was an outstanding success, with discussion continuing afterward such that the room had to be cleared so that the next session could begin. At the meeting, an ALMA booth was manned by ALMA personnel to answer questions. Wootten presented an introduction to plans for the North American ALMA Science Center.

Wilson attended a meeting on ALMA-Herschel synergy at the ESA headquarters in Paris on 11th February and is writing a written report for ESA. Wilson is also working on a contract for the EU program 'ALMA Enhancement' which will bring 8.5 Mio Euros to the project for hardware and software, with some obligations on the part of ALMA pending Board approval.

ALMA newsletters for North America and Europe have been released. Wootten continues to issue a biweekly calendar of events within the NRAO ALMA effort.

Planned activities for next period

- Site - The batteries powering the ALMA/NA equipment at Chajnantor are now ten years old, twice their nominal service lifetime, and are no longer reliable. A plan for their replacement is being developed. Site personnel will be doing ground truth checkout on the terrain map used for configuration development in advance of the redesign. The most recent Digital Elevation Map will be described and made available.

ALMA

- Configuration - Conway, working with Holdaway, will redesign the ALMA configuration for fifty antennas, with provision for placing 64 antennas should that number become available.

- Calibration - Mangum will continue detailed planning for tests on the prototype system integrated at the Antenna Test Facility.

- Imaging - Holdaway will develop better methods of simulating ALMA data. In particular, he will focus on uses of the pointing self-calibration techniques under investigation at the AOC.

- Outreach - ALMA presence at several meetings is planned. Wootten will present a paper at the 2005 IEEE International Conference on Acoustics, Speech, and Signal Processing March 19-23 2005 on ALMA signal processing, during a special session on radioastronomy. An ALMA workshop on ALMA and the S-Z effect will be held in Paris in early April. ALMA information will be available at booths at the CASCA Meeting in Montreal and at the AAS Meeting in Minneapolis. There will be an ANASAC Face-to-Face Meeting abutting the Submillimeter Workshop at the Center for Astrophysics in June.

Appendix 1 - Schedule

Milestone Number	Milestone Name	IPT	Original Due Date	Due Date 04-Jul-2004 Update	Actual	Mitigation Plan
8222	AOS Foundations N.A. Inner Array, Critical Design Review	Site	2003-May-15	2004-Jun-04	?	85% complete version of documentation was submitted by M3. Pending consensus on alternative design.
8224	AOS Foundation N.A. Inner Array, Construction Documents complete	Site	2003-Jul-15	2004-Sep-01	?	Pending consensus on alternative foundation design
8226	AOS Foundations N.A. Inner Array Construction Contract signed	Site	2003-Oct-01	2004-Nov-30	?	Pending consensus on alternative foundation design
8252	AOS Buildings N.A. Foundations/Envelope Tender Documents complete	Site	2004-Mar-15	2004-Jul-30	2004-Sep-08	Complete
8254	AOS Buildings N.A. Foundation/Envelope Contract signed	Site	2003-Dec-31	2004-Dec-06	?	Pending NSF approval of foundation contract.
8258	AOS Buildings N.A. Foundation/Envelope Provisional Acceptance	Site	2004-Aug-31	2005-Mar-31	?	Realistic forecast is contingent on project resolution of scope and budget issues
8260	AOS Buildings N.A. Finish and Installation Design Development Documents complete	Site	2003-Aug-31	2004-Jul-30	?	Realistic forecast is contingent on project resolution of scope and budget issues
8262	AOS Buildings N.A. Finish and Installation Construction Documentation complete	Site	2003-Nov-30	2004-Aug-31	?	Realistic forecast is contingent on project resolution of scope and budget issues. 6 months after 8260

Milestone Number	Milestone Name	IPT	Original Due Date	Due Date 04-Jul-2004 Update	Actual	Mitigation Plan
8264	AOS Buildings N.A. Finish and Installations Construction contract signed	Site	2004-Jul-01	2005-Mar-05	?	Same as 8260. 4 months after 8262
8266	AOS Buildings N.A. Finish and Installation Provisional Acceptance	Site	2005-Jun-30	2006-Mar-01	?	Same as 8260. If work starts in 2005 September, then 2006-Jun-30 is possible.
8310	Access Road EU. Ready to accommodate Transporter	Site	2005-Jun-30	2005-Jun-30	2006-Mar-08	Based on current construction progress road is expected to be ready to accommodate transporter already on 2005-Dec-31 or earlier
8334	Contractors Camp Provisional Acceptance N.A.	Site	2003-Oct-30	2004-Sep-30	2005-May-31	Estimated date contingent on timely NSF approval of contract.
8344	OSF Technical Facilities EU. Tender and For Construction Documents complete	Site	2003-Dec-01	2004-Jul-30	2004-Aug-30	Provisional Acceptance date Complete
8346	OSF Technical Facilities EU. Construction Contract signed	Site	2004-Apr-01	2004-Nov-01	2006-Jan-01 ?	ESO CP restrictions.
8360	Freeze Fiber Optics and electrical Cables specifications N.A.	Site	2003-Jun-30	2004-Oct-01	2005-Jun-30 ?	Expect Fiber Optic Spec. on 2004-Dec-31. Electrical Cable Spec. 2005-Jun-30. Specs for OSF-AOS link 2005-Jan-31
8362	Fiber Optic Cables and Electrical Cables in Chile N.A.	Site	2004-Sep-15	2004-Sep-30		Six months to one year after corresponding parts of 8360
8374	Permanent Power Supply Tender Documents complete EU.	Site	2003-Dec-31	2004-Dec-31	2005-Nov-04	Assumed contract signature for design contract will be in June 2005

North American ALMA Science Center

A work breakdown structure (WBS) for the NAASC was completed for the years 2005—2013. The WBS was summarized in a memorandum that also presented the cost to the NSF and NRC (Canada) using the budget of the Array Operations Plan being constructed by the Joint ALMA Office – Version I2. The AOP(I2) was analyzed by a team inside the NRAO and by outside experts. The analysis of the AOP will be used in the approval process of the ALMA Board. As a check on our estimates of the required staffing levels in various activities of the NAASC, we are comparing our plan with that of the Spitzer Science Center which supports the user community of the Spitzer Space Telescope. Discussions have been held with the SSC Deputy Director and other individuals at IPAC and SSC.

The ALMA Town Meeting held at the San Diego meeting of the AAS was judged to be a success. The next ALMA Town Meeting is scheduled for the Washington DC meeting of the AAS in January 2006, and will build on the experience gained in San Diego. We are planning a series of small, topic-targeted workshops, the first likely to be one on "z-machines." These workshops will be held in Charlottesville in the new facilities provided by the addition to Stone Hall.

The NAASC staff met every two weeks during this quarter to discuss progress on various activities. These activities are now organized into the following areas, activity leaders shown in parenthesis:

Proposal Functions (Ed Fomalont): In Feb2005 in Garching, Ed met with the European group responsible for developing Phase II of the proposal submission tool and reviewed the prototype. He signed to be a tester of this tool. He also has been testing the phase I submission tool being developed by NRAO.

Science Functions (John Hibbard): The Science group (which also includes Al Wootten, Jeff Mangum and Ed Fomalont) participated in discussions with the NAASC staff and the ANASAC on the rebaselining effort. John and Ed are both part of the off-line data reduction testing team, and spent significant time pre-testing for the AIPS++ ALMA Test 2.0. This test demonstrates the capability of the off-line reduction system to combine single dish and interferometer data. The outside testing, by non-NRAO testers, will take place April 15, 2005. The next pre-test is scheduled for 2005Q3.

The science group met with George Helou of the Spitzer Science Center/Herschel Observatory and Tom Wilson of E-ALMA. These discussions focused around the functional organization and staffing levels of the NAASC. We also discussed the generation of a mm/submm spectral-line/calibrator database, which is of interest to Herschel. A goal for 2005Q2 is for the NAASC Science Group is to have the basic structure and simple web-interface for such a tool completed. The hope is to have this tool available for use at the ATF in 2005Q3.

ALMA

Community Functions (Paul Vanden Bout): During G. Helou's visit, we discussed synergistic activities in terms of planning joint ALMA-Spitzer-Herschel workshops. At the face-to-face ANASAC meeting in June 2005 we expect to decide on workshops to be held at the NAASC in 2006.

We are pursuing possibilities for joint activities with other projects on topics of common interest. For example, the spectral line data base may be done in collaboration with HERSCHEL. We may hold joint workshops, for example, one on planet formation with DTM-Carnegie. To that end, the NAASC staff is giving informational ALMA talks. Vanden Bout gave one at the University of Maryland, February 21; and Wootten at the AAS Meeting, January 11, Johns Hopkins, February 1, and the IEEE ICASSP meeting, March 21, 2005.

The ALMA North American Advisory Committee (ANASAC) met three times during this quarter to discuss the issues before the ALMA Science Advisory Committee (ASAC) in advance of the ASAC's March meeting. These issues are largely centered on the consequences of any reduction in the number of antennas or other de-scoping that might be necessary for the Project.

Expanded Very Large Array

Expanded Very Large Array (EVLA) Highlights

The outfitting of the third EVLA antenna is nearing completion and the first EVLA Test Antenna has been withdrawn from service to upgrade its equipment to the current EVLA design. The Canadian correlator effort has completed a major milestone with the award of the contract for the design and fabrication of the EVLA correlator chip to a well-qualified company. It has been decided to use EVLA construction funds to provide two additional FTEs/yr for the e2e software effort. The use of EVLA antennas for routine VLA observing has been delayed due to the need for a redesign of the Digital Transmission System (DTS) module. New DTS modules will be available at the end of the next quarter.

Expanded Very Large Array Milestones

Milestones	Original Date	Revised Date	Date Completed
Start transition Operation planning	01/13/05		01/13/05
LSC converter ready to install on Antenna 14	01/18/05		01/18/05
MIB control band select switches on Antenna 14	12/15/04	01/18/05	01/19/05
FE card cage prototype tested	01/20/05		01/20/05
MIB software ready for F320	01/20/05		01/20/05
Install 6 GHz receiver on Antenna 14	12/16/04	01/18/05	01/24/05
Correlator Chip CDR in Penticton	01/24/05		01/24/05
Formatter MIB slot ID ready for Antenna 14	01/26/05		02/04/05
Vertex room AC power available on Antenna 16	02/04/05		02/04/05
LSC converter ready to install on Antenna 16	02/04/05		02/08/05
Deformatter slot ID ready for Antenna 14	02/09/05		02/09/05
MIB control band select switches on Antenna 16	02/23/05		02/15/05
Correlator shielded room specifications complete	12/15/04	02/07/05	02/16/05
L352 RTP module slot ID available	02/16/05		02/16/05
Feed horns CDR	11/18/04	02/17/05	02/17/05
Move Modcomps	02/17/05		02/17/05
2nd FE card cage assembled & tested	02/22/05		02/22/05
HVAC system operational on Antenna 16	02/23/05		02/23/05
M302 Utility module prelim design complete	03/25/05		02/24/05

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
2 IF bands working on Antenna 14	02/24/05		02/24/05
Multi frequency observing - L & X	07/21/04	01/25/05	02/28/05
T304 (w/ total power detector) MIB software ready	02/28/05		02/28/05
Control Bldg slot ID hardware installed	02/28/05		02/28/05
LO/FE racks installed on Antenna 16	03/01/05		03/01/05
MCB rack installed on Antenna 16	03/01/05		03/01/05
Module package ready for RFQ	02/02/05		03/02/05
45 GHz receiver installed on Antenna 14	10/28/04	01/19/05	03/10/05
Move 2nd test Antenna 14 to array	09/27/04	01/31/05	03/10/05
P, L, X, K & Q-Band receivers usable - Antenna 14	09/13/04	02/08/05	03/10/05
L, C, K and Q-Band receiver remote operation on Antenna 14	02/24/05		03/10/05
Total power and sensitivity improvements	03/10/05		03/10/05
Start Antenna 13 update	03/10/05		03/10/05
First fringes at C & L-Band	03/10/05		03/10/05
Develop new correlator room fire suppression SOW	03/31/05		03/31/05
DTS formatter Rev. E functionally tested	03/31/05		03/31/05
ACU/FR interface w/MIB installed on Antenna 16	04/05/05		
L-Band feed VSWR test	04/06/05		
Verify signal clearance of 45 GHz feed in tower	04/08/05		
UX converter (Norden's) evaluated	04/11/05		
75/328 MHz converter module ready for test antenna	10/24/03	04/11/05	
Routine test observing	05/13/04	04/11/05	
LO/FE racks installed in Antenna 13	04/12/05		
2nd C-Band receiver ready to install w/new card cage	04/12/05		
*L-Band feed horn installed on Antenna 16	04/12/05		
Voice over IP phone tested	04/13/05		
Electronics hardware installed w/1 IF-Band	04/14/05		
Operators EVLA M&C training	04/15/05		
Start VLA old computer floor removal	04/15/05		
Verify linearity of RF designs – receiver to correlator	05/27/04	04/15/05	
L301 and L302 integrated module ready for Antenna 16	02/22/05	04/15/05	

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
L352 RTP side by side tests	04/18/05		
T304 digital control board assembled & tested	04/18/05		
D30x ICD (revision E) ready for software	04/18/05		
*Antenna 16 ready to move to E14	04/19/05		
Antenna 16 move to Array	02/04/05	04/19/05	
Fabricate NRAO Q-Band MMIC post amplifier	07/16/04	04/21/05	
T304/T305 base band converters ready to install	05/02/05		
Move Antenna 18 into AAB	05/03/05		
Pattern measurements of metal version C-Band horn	05/03/05		
L-Band receiver installed on Antenna 16	05/04/05		
DTS revision E formatter tested	05/05/05		
Front Ends CDR	05/05/05		
C-Band feed installed on Antenna 16	05/05/05		
First fringes on Antenna 16	03/02/05	05/05/05	
C-Band receiver installed on Antenna 16	05/06/05		
Check for interference and bandpass shapes: 8, 22 & 45 GHz	03/15/04	05/12/05	
Receiver stability tests: 8, 22 and 45 GHz	12/19/03	05/12/05	
Complete assembly - M301 DAQ1 board	05/16/05		
MIB control band select switches on Antenna 13	10/21/04	05/18/05	
D30x MIB software ready	05/20/05		
Next two F320 modules ready for MIB software	05/20/05		
WBS Updates	05/23/05		
M301 hardware ready for software	05/27/05		
Complete Part 1 hardware bench integration	03/03/03	05/30/05	
Start production F320 FE transition module	03/28/05	06/01/05	
Two F317 modules w/ MIB tested and ready for software	09/08/04	06/01/05	
Delivery of 12 low noise receivers to CONACyT	06/01/05		
M301 module ready to install on antenna	06/08/05		
M301 converter interface module ready for software	10/07/04	06/08/05	
WBS Schedule Updates	06/20/05		
4 IF's on Antenna 14 working	09/13/04	06/23/05	

Expanded Very Large Array

Milestones	Original Date	Revised Date	Date Completed
4 IF's on Antenna 16 working	03/09/05	07/01/05	
New time synchronization reliability	02/15/05	07/08/05	
4 IF's on Antenna 13 working	03/31/05	07/08/05	
Start transition mode observing	03/15/05	08/17/05	

Management

NRAO has signed a contract with the Mexican CONACyT for them to fund assembly of 12 low noise receivers and two antennas worth of electronics hardware. This will expend the Mexican funds pledged for the EVLA Project. As a condition of the contract, the 12 low noise receivers will be delivered on June 1, 2005 and the electronics for two EVLA antennas will be delivered on October 14, 2005.

Bryan Butler was appointed to the position of EVLA Project Engineer for Software, replacing the retired Barry Clark. Bryan previously held the position of EVLA Project Scientist for Software.

Other activities this quarter:

- Developed a response to the project's 2004 Advisory Committee report.
- The project began transition planning sessions to coordinate key tasks necessary to interface EVLA antennas into the VLA operations.
- Budget planning sessions were held to reconcile budgets between Operations and the project. An agreement was reached with respect to the project assuming the cost of some of the Contributed Effort previously provided by the Operations budget.
- The project began use of the NRAO-wide online requisitioning process. The project's purchase order effort should soon become less time consuming.

Systems Integration

The second EVLA antenna, (VLA Antenna 14) has now become the primary EVLA Test Antenna. Band switching functionality was added to Antenna 14. Users can now operate the antenna with two IF's in L, C, X, or K-Band. Testing of Antenna 14 is ongoing.

The first EVLA Prototype antenna (VLA Antenna 13) has been withdrawn from service to upgrade its equipment to the current level of EVLA design. The outfitting of the third EVLA antenna (VLA Antenna 16) is nearing completion.

The use of EVLA antennas for routine VLA operation has been delayed by the need to redesign the Digital Transmission System (DTS) module (see Fiber Optic report below). The Formatter Board has been completed and the assembled boards appear to be working and ready for use. A re-spin of the 8 bit

digitizer board to allow the use of an updated Demux IC was completed in late March. The board is being fabricated now and should be ready when the new IC arrives in early May. The new DTS modules will be available at the end of the second quarter 2005.

Civil Construction

Preparation and clearing of the shell space for the new WIDAR Correlator room continued. Elsewhere in the VLA Control Building electrical work needed to move the Modcomp computers was done. The VLA Modcomp computers were successfully relocated in February 2005. The demolition of the old VLA computer room has begun for the new Correlator shielded room.

The bid specifications for the Correlator shielded room package was completed and sent out for RFQ. The bids are due to arrive in early April. A finalized Statement-of-Work for the fire suppression system going into the new shielded room was completed. The RFQ for the fire suppression system will be requested later in coordination with the arrival of the shielded room package.

The new Correlator electrical power requirements now indicate the need to add an additional 500KVA transformer for its primary power supply. Plans are being developed to purchase and install the unit in late July 2005.

Antennas

The mechanical outfitting of Antenna 16 was completed. All electrical, heating and cooling systems were checked out early in the quarter. The construction of feed cone #4 started. The feed de-icer design is complete and the prototype brackets were fabricated and installed onto the feed cone mockup to verify fit and clearance of feed signal paths. A redesign of the MCB rack was done to improve air flow through the Ethernet switch which it houses. The rack is now into production.

The EVLA Feeds Critical Design Review (CDR) took place in February, and the external panel had no objections to moving forward with all the new antenna structural changes. Several antenna structural subassemblies of the EVLA design have gone into production. Pre-assembly of these items will help to shorten the outfitting cycle of antennas for the remainder of the project.

Front End (FE)

A comprehensive series of efficiency and spillover tests were carried out with the 4-8 GHz feed and the C-Band "interim" receiver installed on EVLA Antenna 14. The G/T performance was found to adequately satisfy the EVLA Project Book requirements. The EVLA Feeds Critical Design Review (CDR) and the external panel commended the NRAO design team on their "excellent horn designs which will greatly increase both the sensitivity and the frequency coverage of the VLA". The panel also recommended that additional work be carried out on such issues as RFI containment, providing adequate

documentation on fabrication procedures, and determining the effect of the mounting tower on the Ka and Q-Band feed pattern.

EVLA Antenna 14 now has a complete suite of core receivers – L, C, X, K and Q-Band - and is now fully outfitted for cm-wave observations. Its Q-Band receiver is the first to use a new limiting amplifier in the LO chain which will protect the 40-50 GHz frequency triplers from damage arising from excess drive levels.

The design phase of the L-Band OMT prototype is now complete. The return loss is better than 18 dB across the prime 1.2-2.0 GHz frequency range, degrading to about 14 dB at 1.0 GHz. The isolation is greater than 30 dB across the full octave band. Its novel design also significantly suppresses the resonances from trapped modes. The next step will be to carry out cryogenic tests on the OMT. This will also involve the evaluation of a new 7.5" diameter vacuum window.

The prototype Card Cage designed for the new generation of EVLA receivers has been evaluated with satisfactory results and procurement of production quantities will soon begin. A commercial solution for the enclosure is being investigated and looks promising—the new scheme will eliminate a large amount of machining and assembly effort.

The lamination of the new 2-section L-Band feed is complete. Improvements have been made to the so-called "Christmas Tree" apparatus which is used to stack the rings and bands during the lamination process. The fabrication of the new all-machined version of the C-Band feed is also in the final stages. The test equipment and data acquisition software for the new EVLA Outdoor Antenna Test Range (OATR) are essentially complete and ready for use. The range will be located on New Mexico Tech property and the pouring of the concrete pads is slated to begin in late March. The OATR will be used to test the new L and C-Band feeds before installation on the 3rd EVLA Antenna.

The FE Rack has been mounted on Antenna 16 and the cable trays have been installed. An existing VLA X-Band receiver has been modified with new post-amps to supply additional RF gain. A K-Band front-end had its LO/IF chain upgraded to accommodate the new EVLA Block Converter scheme. An L-Band system is in the process of being outfitted with the new EVLA low-noise and high-power LNA configuration. The second new C-Band receiver, which is the first receiver to utilize the new EVLA Card Cage, is nearly ready to undergo RF tests in the lab.

Local Oscillator (LO)

Redesign of the L305 and L350 have been completed and the new board layout is very near completion. The layout for the new L353 boards will be completed next quarter. Integrated assemblies for the L301 and L302 synthesizers have been received from MITEQ and these assemblies represent a significant cost saving with improved performance. The L301 and L302 are now in full production. Tests are continuing with the round-trip phase system and should be completed next quarter.

Expanded Very Large Array

Fiber Optics

The formatter board on the DTS module was completely redesigned with new FPGA's after discovering an inherent timing issue with the old design. A prototype board has been built and tested successfully. Likewise the 8-bit digitizer board has to be redesigned due to the multiplexer chip not meeting the manufacturer's specification. We are currently waiting for the delivery of different multiplexer chips. Assembly of other parts of the DTS modules continues and three antennas should have all four DTS modules by the end of next quarter.

Antenna 13 is being re-outfitted with all new fiber along with Antenna 16. The simultaneous work on both antennas is necessary to continue on schedule. Antenna 14 is nearly finished with the fiber installation and its pad (CE7) has been prepared as an EVLA pad. Altogether, there are now 14 pads that are EVLA ready.

Round-trip phase testing continues out at the VLA site. There are four L352 modules now working and research into the round-trip phase stability continues comparing the phase shift during temperature changes and antenna movement.

Intermediate Frequency System

The UX converter T303 prototype unit was received from the vendor and will undergo extensive testing next quarter. The 4P converter has been redesigned and the new board layout is starting. The LSC converter is now ready for full production. The base-band down-converter is still lacking the total power digitizer and the gain equalizer. The total power digitizer is very near completion but the equalizer will not be ready until Q3 2005. The equalizer is not needed until operation with the new EVLA correlator commences in 2008. The M301 converter interface will be completed next quarter.

Correlator (HIA report)

The correlator chip contract has been awarded to Innotech Systems Inc. This is the same contractor that built the ALMA correlator chip. A successful Critical Design Review of the chip design and implementation plan was held in Penticton January 24-26. The design of the chip has been finalized and we are working with the contractor on an as-needed basis to assist in the implementation of the chip. Delivery of first prototypes is expected in Q3 2005.

In mid-May we expect to take delivery of some first prototype circuit boards to allow us to perform an end-to-end test of the internal 1 Gbps data transmission system in the correlator. A test of the long 10 m cable was successfully performed using the 1 Gbps PECL transceivers in our existing VLBI correlator, adding confidence that the chosen cable should perform as expected in the end-to-end test in May.

Expanded Very Large Array

Our circuit-board design engineers are busy working on place-and-route of the large Station and Baseline Boards that perform the core signal processing in the correlator. These are large complex boards with up to 200 BGA (Ball Grid Array) devices on them, and they represent significant design challenges. The boards have revealed performance bugs in the PCB design software we are using, however, the design software vendor has fixed these bugs in reasonable time. It is the place-and-route of these boards that is on the critical path to obtaining first prototypes for testing. Nevertheless, our target date for first prototypes is the end of August, and we are doing everything possible to achieve that goal, but uncertainty in that date will remain until place-and-route is complete. We have been visited by multiple extremely capable PCB contract manufacturers that are aware of our requirements and are anxious to be awarded the contract for PCB fabrication. The tendering and bidding process for turnkey construction of all of our PCBs through to production is expected to start by mid April.

The correlator rack design and thermal testing has proceeded successfully, and we are now in the process of generating detailed drawings for the rack and rack components using SolidWorks. These drawings and specifications will allow us to proceed smoothly through the required tendering and bidding process for fabrication of this hardware. We have been in close communication with NRAO regarding the correlator room layout, construction, and power requirements.

Kevin Ryan (NRAO) has recently joined the correlator software development team and will be working on implementation of GUIs that allow engineers powerful capability for accessing hardware device drivers to facilitate board and chip testing. It is expected that not only will these GUIs be used for prototype testing, but that they will provide significant debugging capabilities in system integration and testing and on to normal operations.

Monitor and Control (M/C)

Two reports, available on the EVLA Computing Working Documents web page, were issued during Q1 2005. The first, entitled "EVLA Monitor and Control Communications Infrastructure, Version 1.0.2", characterizes the information that must be distributed within the EVLA Monitor and Control System. The second report, titled "EVLA Monitor and Control Transition Software Development Plan, Version 1.0.0", gives the task breakdowns for the development of the software needed to replace the VLA Control System with an EVLA Control System capable of conducting observations using the hybrid array (EVLA antennas, VLA antennas, VLA correlator). It will be incrementally expanded to become an overall EVLA Monitor and Control Software Development Plan.

It is now possible to submit VLA Observe files to the EVLA Observation Executor. The interim Observation Executor now includes software that recognizes a VLA Observe file and automatically translates it into an EVLA control script. Most of the capabilities that can be specified via a VLA Observe file are supported.

A general framework has been developed for the implementation of GUIs for operational software processes. GUIs using this framework have been developed for the Observation Executor, the monitor data archiving task, a Checker prototype (displays alarms and alerts), and for the EVLA flagging process. The GUIs to the Executor and to the monitor data archiving task are now used on a regular basis. VLA Operator training on the use of these GUIs is scheduled to begin early in the next quarter.

Multicasts of monitor data generated at the AOC (test rack and test benches) are now forwarded to the VLA site. This successful re-configuration of the EVLA network has made possible a final proof of concept and feasibility for the architecture of the monitor data archive. One monitor data archiving task, running at the VLA site, now archives all monitor data generated at both the VLA and the AOC.

A decision has been made to refactor the current, interim Observation Executor into an Observation Executor and a separate layer of Antenna Servers. It was felt that this separation will better support the functionality required and better handle the issue of different antenna types. A team has been formed to develop this revision of the software architecture.

Data Management

ALMA has been receptive to modifications to its ALMA Science Data Model (ASDM) suggested by the EVLA. This tentative agreement on a common science data model between ALMA and EVLA has the potential to greatly facilitate EVLA benefiting from ALMA developments in data capture and archiving.

Prompted by the EVLA Advisory Committee's report, we are in the process of putting together a High Level Architecture (HLA) team. This team will further refine the Overall Design, as presented in mid-2004, to the point where meaningful subsystem design can start.

The EVLA Advisory Committee also strongly suggested adding manpower resources to the EVLA e2e effort. The decision has been made to add two FTEs using EVLA contingency funds, and recruitment for these positions has started. With two new hires in place, we will be in a better position to monitor and exploit activities in corresponding ALMA Integrated Product Teams (IPTs).

In post-processing, one FTE in the Science Software group has been working on the EVLA specific application of wide-field imaging. Testing by staff scientists is expected to start in spring 2005.

The NRAO-wide proposal tool and user database project made excellent progress in 2005, and we expect to release it to the astronomical community in April 2005. Although focused on the GBT, its instrument dependencies are isolated, and it will eventually benefit the EVLA. Progress in this area is described in more detail elsewhere.

Green Bank Telescope

Green Bank Telescope (GBT) Highlights

The scheduled observing time on the GBT reached an all-time high of 69% of total telescope time in the first quarter, based on a 24-hour per day observing schedule. This percentage was achieved through continued improvements in the efficiency of maintenance and test activities. The effective observing time is also increasing through improved observer tools and resulting reductions in observing setup time.

Astrid, the Astronomer's Integrated Desktop, was released for staff evaluation at the end of the quarter. Astrid will provide a single control panel through which GBT observers will have access to all the applications, documentation, and feedback utilities that are required to conduct an interactive local or remote observing session. It greatly simplifies initiation of an observing session and the management of observing tools and their displays. As Astrid develops, it will allow interaction with the Observation Management database. To facilitate remote observing, Astrid was designed such that remote observers can launch the application on a Green Bank machine, run all processes on this machine, but view the displays remotely using the VNC protocol. Early tests have demonstrated good performance in remote applications.

GBT Milestones

GBT Antenna & Operations

Milestones	Original Date	Revised Date	Date Completed
Complete development of new rail concepts	12/31/03	05/01/05	
Final recommendations for track repair	06/15/05		

GBT Electronics

Milestones	Original Date	Revised Date	Date Completed
Spectrometer Upgrades			
Cross-correlation/poln. test fixture designed	01/01/04	1/15/05	
Cross-correlation/poln. test fixture constructed	03/01/04	04/08/05	

Green Bank Telescope

Milestones	Original Date	Revised Date	Date Completed
Begin polarization mode checkouts	06/01/04	04/17/05	
LTA Prototype construction complete	02/15/05		03/31/05
LTA Test and Debug complete	04/15/05		

GBT Mechanical Engineering & Central Shop

Milestones	Original Date	Revised Date	Date Completed
GBT RFI Antenna Mount Design	10/29/04	04/15/05	
Test Building Receiver Handler	10/15/04	04/30/05	
3 mm Quartz Windows	10/31/05		
Penn Array Electronics Crate GBT Mount	03/31/05	04/29/05	
Ka-Band MMIC Amp packages (10)	02/25/05		01/21/05
EVLA X-Band Feed	04/29/05		
Solar Burst Antenna	06/30/05		

GBT Software & Computing

Milestones	Original Date	Revised Date	Date Completed
Deprecate IARDS	03/31/04	08/15/05	
Complete Linux Migration	06/30/05		
Eliminate Backlog of Software Maintenance Requests	12/31/05		

GBT Projects

Milestones	Original Date	Revised Date	Date Completed
PTCS			
Identify 1" level contributors to pointing error	09/30/04	project on hold	

Green Bank Telescope

Milestones	Original Date	Revised Date	Date Completed
Ready for prototype W-Band operation under benign conditions	10/01/04	project on hold	
Ease of Use			
Production Release of HLAPIs & Online Filler	Task reorganized Q4 04	06/30/05	
Complete "Phase 4" of Observing API (non-sidereal objects, source catalogs)	06/30/05	12/31/05	
Remote Observing Specifications Written	12/31/04	Task reorganized	
Data Handling			
Generate requirements for imaging	12/31/03	09/01/05	
Analysis Conceptual Design Review (In-Progress Software Review)	05/30/05		
Beta of IDL package for standard observing modes available to external reviewers	2/15/05		2/15/05
Production release of IDL package to GBT users	05/15/05	05/30/05	
First draft of GBT Science Data Model	03/31/05	06/30/05	
Ka-Band (1cm Rx)			
Penn Array Receiver			
Detectors Delivered to Penn	05/17/04	08/31/05	
Full Lab integration at Penn	09/06/04	09/30/05	
GBT Commissioning begins	02/21/05	11/30/05	
3 mm Receiver			
Construction complete	02/15/06		
Caltech Continuum Backend			
Complete CCB design	03/31/04		03/31/05
Master Board laid out	04/30/04	05/31/05	
FPGA program synthesized and simulated	03/31/04	04/30/05	
Finish Packaging drawings	05/31/04	05/31/05	
Construction and lab testing complete	08/27/04	10/31/05	
Commission on GBT	09/06/04	11/30/05	

Green Bank Telescope

GBT/Green Bank Overview

The scheduled observing time on the GBT reached an all-time high of 69% of total telescope time in the first quarter, based on a 24-hour per day observing schedule. This percentage was achieved through continued improvements in the efficiency of maintenance and test activities. The effective observing time is also increasing through improved observer tools and resulting reductions in observing setup time.

Considerable progress has been made in the observer Ease of Use initiative. At the end of the quarter, the initial version of the Astronomer's Integrated Desktop (Astrid) was released. The intent of this application is to provide a single application through which all required observing tools can be launched, including the Observation Management system for processing scripted Scheduling Blocks. A number of observers are already using the Python-based scripting language to prepare configuration and observing scheduling blocks. By preparing the blocks in advance, observing session startups can be made fast and efficient.

GBTIDL, the IDL-based data reduction package is now in beta release for testing by staff scientists and a few external scientists. This project is on schedule for a June general release. The package will provide a powerful but familiar reduction system that can be easily extended by users. It is also providing a platform to develop a "science data model" for the GBT that will be used for next-generation data analysis systems.

The azimuth track project group is producing final designs for the track retrofit and is submitting drawings and specifications to vendors for preliminary price quotations. This process should conclude in May, at which time final recommendations will be available for review.

GBT Azimuth Track

We have begun the final design phase for the retrofit of the track, incorporating the comments from the external panel review in December 2004. Simpson, Gumpertz, and Heger are modeling some details of the design, including a wider and thicker wear plate. We continue to discuss materials and design components with suppliers, have obtained rough cost and schedule estimates from them, and are developing drawings to obtain more precise costs. We are also evaluating and incorporating measures to reduce costs, improve handling and maintenance, and facilitate installation. Based on the lead time expected by manufactures, the full retrofit is planned for summer 2007.

Telescope Operations Activities

Telescope Operations has been busy on non-GBT maintenance days with the re-commissioning of the 43 meter telescope and support of the solar spectrometry project for the 45 foot telescope. Both efforts are coming along well. The 43 meter telescope mechanical systems are in service, and the telescope

can be moved manually to accommodate cleaning and maintenance activities. When a position readout system is available early in the next quarter, we will move the telescope over to the service tower and inspect and test the receiver mounting and systems.

Maintenance on the GBT has been confined to two dynamically scheduled days each week during the winter months, to maximize the opportunity for observers to observe in good weather. We have focused on preventive maintenance tasks, and also continue to maintain the track, particularly shimming to minimize wheel tilting at the joints and fatigue of the wear plates. This work pattern will continue through April and May, and begin a four day per week painting season in the summer months.

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 machine shop electronic repair. Some specific activities of the three groups are reported below.

Digital Group Activities

Most of the digital group's time was spent on PTCS activities, 45 foot telescope servo support, Spectrometer support and development, and the Caltech Continuum Backend project.

Approximately four FTE's were supplied to the PTCS project for sensor construction, installation, maintenance, and calibration work, along with active surface maintenance. The 45 foot telescope servo system software development with the hardware mockup was completed. This antenna is being readied for use with the Solar Radio Burst Spectrometer for studying the Sun over the next two years. Resources were shifted to the 43 meter (140 foot) antenna servo upgrade, which will use some of the same hardware and software, which will delay the 45 foot telescope upgrade until the fall.

Spectrometer development concentrated on two areas this quarter LTA card replacement, and cross-correlation testing. The first LTA replacement card was received from the fabricator, and testing and debugging is underway. Cross-correlation testing concentrated on the development of a test fixture, and a filter module similar to that in the GBT IF system. The spectrometer is fairly reliable although it occasionally produces obviously bad data. Trouble-shooting and repair accounted for only a small amount of the time spent on the Spectrometer. About two FTE's are provided to the Spectrometer.

The Digital Group is supplying engineering to assist the Caltech Continuum Backend project. We are designing all of the hardware, including the packaging design. About 1.5 FTEs are assigned to this task. Other items that the Digital Group is involved in are GBT servo system support, repairing and maintaining printers, network cabling, and communications hardware on the GBT.

Green Bank Telescope

Microwave Group Activities

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

Support for operational receivers was routine this quarter. The K-Band and Q-Band receivers saw heavy use during the good high frequency weather. Some work was done in conjunction with the scientific staff to improve the receiver calibrations. A stability problem arose late in the quarter in one L-Band channel and is being addressed.

The 26-40 GHz receiver was commissioned, observations were completed, and outside observers began using it. Some additional development is needed in the LO Distribution module to obtain enough power to drive four mixers, and is underway. Work continued on the 3 mm (68-92 GHz) receiver construction project. Progress was made on design and construction of the receiver monitor and control circuitry. Technology for applying matching layers to quartz vacuum windows was transferred from the Charlottesville engineering staff, and one 68-92 GHz window was completed.

New IF amplifiers designed and constructed at Green Bank were installed. Various module instabilities and failures were repaired, and efforts continue to improve gain stability with better temperature control and other steps.

The outdoor antenna range upgrade was completed. This will provide better positioning, instrumentation, and software for doing antenna measurements. The indoor range also saw some use for higher frequency measurements.

We continue to develop amplifiers around commercial MMIC chips, including a 8-18 GHz LO amplifier and a 0.5-8 GHz medium power IF amplifier. Several microstrip bandpass filters were also designed, developed, and produced.

RFI Management

S-Band spectrum research and satellite data were provided in support of the Huygens probe observations.

The VHF band was monitored to identify transmitters seen by the Epoch of Re-ionization experiment site at 85-1. Several paging transmitters in the 152.xx and 158.xx MHz band have been identified as being outside the NRQZ.

A WIKI page (*http://wiki.gb.nrao.edu/bin/view/Projects/RFIReportsTable*) of known RFI was developed. This information is available through a link on the RFI Management web page (*http://www.gb.nrao.edu/IPG/*) and will be continually updated as RFI sources are identified.

Green Bank Telescope

The NRQZ office completed 14 requests for preliminary evaluation on 71 proposed transmitter sites. 47 regular applications for 99 sites were also completed. ERPd restrictions were requested on 10 sites and no objections were filed. Two site inspections were performed. An uncoordinated site was discovered at Spruce Knob and will be investigated.

An extensive preliminary evaluation for a proposed unlicensed wireless network at Snowshoe resort was performed. The proposed system would provide wireless networking to the bottoms of the chair lifts for handheld units. Fifteen locations were evaluated for interference potential. Both 802.11b and 802.11g standards were evaluated.

Coordination of wireless microphones proposed for use at a church under construction at Snowshoe identified an RFI potential at the proposed UHF frequencies. Suggestions to use alternate equipment, such as VHF, were made to the vendor who was coordinating.

A letter was sent outlining NRAO's position regarding Highland New Wind Development's proposed wind farm atop Allegheny Mountain in Highland County, Virginia. Efforts for another proposed wind farm located in Pendleton County, WV, have been temporarily suspended by the developer.

Community RFI suppression efforts continue with the location and mitigation of power line and cable TV interference. Reports from the Solar Radio Burst Spectrometer Project of a very clean 20-70 MHz band indicate that these efforts are paying off. A project is underway to replace the fluorescent lighting ballasts in the Green Bank public library with quieter ballasts.

Progress continues on the GBT-mounted RFI monitoring station. The PIC-based controller board has been fabricated and tested; the RFI/weather tight enclosure is being modified in the shop.

The OASIS II spectrum analyzer control software package was installed for evaluation at the 40 foot RFI monitoring station. In addition to routine RFI monitoring, this software (if purchased) would be used to control the spectrum analyzer via a remote desktop. This would allow the GBT operators and astronomers to use the system from the control room. A software package that reads Morse Code IDs was purchased.

A presentation about the NRQZ was given to the IEEE EMC society in Dearborn, MI.

On-site RFI management included anechoic chamber testing of equipment to be installed at the 140 foot antenna in conjunction with the Lincoln Laboratory Ionosphere Study project. At the Science Center, the HVAC filter replacement was completed, RFI filters were installed on the thermostat control line between the computer room and classroom, and the RFI enclosure design for the C3 compact fluorescent fixtures was finalized.

A meeting was held to plan a strategy for the measurement phase of validating our propagation model. The Navy will potentially provide some manpower and equipment. Initial efforts will be to conduct measurements of existing transmitters to establish our measurement process and determine which factors to account for.

Jeff Acree, NSWC, continues in his effort to acquire Coherent's T-REX, a portable RF collection system, for NRAO use.

Mechanical Engineering and Central Instrument Shop

The Mechanical Engineering Division has been working to prepare the various track configurations for quoting. The interplay of steel prices, steel processing costs, and plate fabrication costs have necessitated the preparation of six plate options to determine the most cost effective approach.

Central Instrument Shop work included both large and small work this quarter. Work is nearly complete on a pair of EVLA X-Band feed horns. These are the largest machined feed sections ever fabricated in the shop. On the other end of the spectrum work continued on 3 mm receiver and Ka-Band receiver parts including the completion of 10 MMIC amplifier bodies and several splitters. Of special interest is the process development for the fabrication of quartz windows for the 3 mm receiver. The flatness requirements for these windows are a challenge but the processes, developed by the shop and Bob Simon from Electronics, have worked out nicely. A prototype has been completed and is ready for testing. A pair of antennas for the Solar Radio Burst Antenna are being developed and fabricated in the shop as their physical and technical requirements coalesce. ALMA work in the shop this quarter consisted largely of receiver cold load components. Development and fabrication of the cold load assembly components will carry over into the second quarter.

Software Development

The SDD produced two regular releases of its key product, M&C, with v5.1 on February 16, 2005, and v5.2 on March 30, 2005. For v5.1, several software managers were moved to the Linux machine fire, including PF1 and PF2 receivers, the LO1 Router, the Prime Focus (PF) Support Rack, the IF Rack and the Motor Rack. IF Rack balancing was improved to converge to a better solution if insufficient input power is used. The PF receivers were made synchronous. For v5.2, archaic libraries (for which source code no longer exists) were removed from the IF Manager. This step was required to be able to use an up-to-date compiler to build the control system, as well as to support the migration to Linux RedHat Enterprise 4 from RedHat 9 this summer. Updating the operating system on which the control software runs is necessary to ensure that the computing divisions can continue to provide support and security updates. As of this release, the IF Manager also recognizes splitters in the PF receivers, and the antenna treats beam designations "1" and "C" (for center beam) equivalently. A group of small updates was made to the generic interface to the control system as well, to make it more resistant to ineffective uses of memory by clients using the service.

Problem resolutions were provided for several issues in the GBT Observe (GO) glish application, since this will continue to be used while we make the transition to the new Scheduling-Block based observing system. These fixes included: retaining the velocity and velocity definition while changing observing modes, the nod procedure always using zero rates, the peak procedure choosing its own offsets, repairing the procedure iteration count (which was sometimes inaccurate), and limiting the damage offline users in simulate mode could unwittingly inflict on live observing.

The GBT quick-look data display, GFM, was updated twice during the quarter on the same release dates as the M&C product. As of February, the user may now switch between "standard," "relaxed," and "user-defined" heuristics for fitting using the Pointing and Focus plugins. These heuristics allow the user to determine, for example, the minimum amount of baseline required to be able to fit a gaussian to data. Several other options are also available; all have been well received by the scientific staff. Other smaller improvements were also made: GFM now determines track beam based on information produced by the antenna; the status bar was updated to include information about receiver, feeds and polarizations used; security was added so that a user working offline cannot inadvertently update local pointing/focus corrections. For the late March release, GFM was augmented with auto-update capability eliminating the need to restart the application if the project ID changed, messaging and log file output capabilities were improved, and an error was added if the observer attempts to observe outside the nominal range of a receiver where there are no measured Tcal values available.

Because AIPS++/DISH is still being used for some offline data processing of GBT results, new updates are occasionally made available. During Q1 2005, a new AIPS++/DISH was released in conjunction with M&C 0v5.1. It features improved memory use, more consistent use of data flags, and two improvements related to averaging spectra. First, the ‘d.ave’ procedure has an sclear argument that allows the user to choose whether or not to clear the accumulator when the average is calculated. Additionally, ‘d.accum’ takes an optional argument which allows the user to specify which IF is used when doing an accumulation.

The SDD delivered 93% and 83% of committed tasks, respectively, in these first two development cycles. This is measured as the proportion of deliverables committed to, versus the total number of deliverables completed and approved by the task's sponsor by the end of the cycle. The lower value in C2 was due to overscheduling of SDD resources.

Work on the Ease of Use project focused on the release of the Astronomer's Integrated Desktop (astrid) to staff astronomers for evaluation, and making improvements to the Balancing API to support balancing the BCPM as well as being able to balance while a scan is underway. This is a major new addition that will significantly help pulsar observers on the GBT. As in Q4 2004, minimal effort was put into Ease of Use so that available resources could be focused on the Data Handling project and maintenance and enhancement activities, to strengthen existing capabilities. Updates and additional details for the two projects are described in the projects' respective sections of the report. The focal activity for the Data Handling project this quarter was preparation for the premier release of GBTIDL at

the end of May, and the focus of maintenance activities was the continuation of the Linux Migration project.

Note also that the 2005 In-Progress GBT Software Review has been scheduled for Tuesday, May 3, 2005. On this day, members of the e2e Oversight & Advisory Committee and others from around NRAO will evaluate the progress of GBT software since last August. The group will ensure that GBT software work is aligned with Observatory-wide expectations to the extent that is feasible given this year's particularly austere budgetary and resource challenges.

Computing

Hardware

A number of new machines have been deployed by the computing division to support the upcoming roll out of the Web Based Business Services. A new multiheaded linux system was installed in the control room to replace the aging solaris workstation. In preparation for the arrival of the summer students, several new machines have been ordered and these will be trickled down to those most in need after the students depart.

Software

The Green Bank classic AIPS installation has been updated to the 31Dec '05 release with assistance from Charlottesville. Apart from this there have been only minor changes. In preparation for the upcoming Linux upgrades, a number of Red Hat Enterprise Linux systems have been installed. These are to provide access for testing and development. This version of the Red Hat operating system will be rolled out in the near future.

Network

The network monitoring system set up last quarter has been expanded. A number of network conditions now trigger automated warnings via email to the appropriate personnel. This gives us sufficient warning to correct the situation before major problems occur.

More work has been done in preparation for the deployment of the new equipment room switch and this work should now be completed early in the next quarter. The private data network between the main data reduction machines has now been completed and is being heavily used by the pulsar spigot community.

Planning for the next round of network upgrades has also been started.

Development Projects

PTCS

Formal Deferment of the Project

Although good progress has been made on the project this quarter, it has become clear that we will not be able to staff the project to the level proposed at both the conceptual and interim design reviews. The Project Scientist (Jim Condon) and to an extent the Project Manager (Richard Prestage) continue to be unavailable due to the pressure of other duties. Outstanding vacancies in the Software Development Division have meant the project continues to be severely hampered in this area. It became apparent during the quarter that the 2005 and probably the 2006 budgets will not be as good as we had hoped. The GBT was proceeding with a number of projects on the basis that current staff vacancies would be filled; it is now apparent that not only will we not be able to fill all of these, but that we will lose additional staff through voluntary reductions. At the same time, we have added the MIT-Lincoln Labs 43 m project as a major new activity, without corresponding new hires. In the light of these realities, we have decided to defer the PTCS as a formal project at this time. Richard Prestage and Kim Constantikes will stand down as Project Manager and Project Engineer respectively. We will continue to document the results of our out-of-focus holography measurements described below, and hopefully release this process for production use. However, major continued development of the PTCS will halt until such time as we can reconstitute a full-time project team with appropriate staff covering all the required disciplines.

Progress during the quarter is described below.

Pointing/Focus: GBT pointing performance remains stable, and no significant work has been done in this area during the quarter. Q-Band observers in particular have reported excellent stability of both pointing and focus under benign night-time conditions. GFM updates are essentially complete apart from largely cosmetic improvements (e.g. improved plotting).

Instrumentation: We now have a notional system design for a fixed surveying network on the GBT that can plausibly achieve the requisite pointing performance for 3 mm operations. This would use inclinometers mounted above the azimuth encoder to provide an absolute reference to local gravity, and fixed-range range and angle-angle measurements to relay this co-ordinate frame to each end of the elevation axle in the first instance. The design has a variety of good properties, e.g., all weather operation. This approach would allow us to compensate pointing for effects in the alidade, including wind and azimuth track irregularities. Prototyping of the new rangefinder design to support this approach continued throughout the quarter.

Surface Efficiency/Holography: We have had a concerted campaign of out-of-focus holography and efficiency measurements, throughout the quarter, ably assisted by our new postdoc, Bojan Nikolic. We have refined our techniques and can now routinely complete and process a set of out-of-focus holography maps in under half an hour. We are now concentrating exclusively on bright continuum calibrators (e.g. 3C279, 3C345) at either Ka-Band (dual-frequency 30/38GHz) or Q-Band (43GHz). We have performed a series of internal consistency checks (such as using the primary surface actuators to induce an large radial focus error, and then checking the equivalent compensation required at the subreflector) to ensure the various stages of measurement and compensation are working correctly. We measure large-scale surface errors of between ~200 and 350 microns over reasonable ranges of elevation and thermal conditions. These correspond to "large-scale efficiencies" of ~0.9 to 0.75 respectively. A single cycle of measurement, adjustment and re-measurement seems successful at removing the bulk of these large-scale errors, and on at least one occasion we have been successful at transferring results measured on one night to improvements on a second night.

Unfortunately, throughout the quarter, we were once again plagued by bad weather, and obtained essentially no useful absolute calibration measurements. We were finally successful with a period of ~24 hours during April 10-11, when we obtained some excellent quality data on 3C286 and some secondary calibrators. These data are now been actively analyzed.

Ease of Use Project

The Ease of Use project is underway to make it simpler for observers to configure the telescope and perform observations with the GBT. It includes the ability to define observations in advance of observing, the ability to execute those observations, improved monitor and status information while observations are executed, and an improved real-time display.

The major accomplishment during Q1 was the release of the Astronomer's Integrated Desktop (Astrid) to staff astronomers for evaluation, and the inclusion of enhanced balancing capabilities for the BCPM and to support pulsar observers who need to balance as a scan is being executed. The vision for Astrid is that the astronomer launches one application and has access to all of the applications, documentation, and feedback facilities that are required to conduct an interactive local or interactive remote observing session. Similarly, we envision that the astronomer whose programs are scheduled in an automated dynamic fashion will be able to use the integrated desktop to interact with the Observation Management database. The system was designed such that remote observers can launch the application on GB machines, run all of the processes on the server side, and use VNC to deliver the requisite performance required for remote interactive observing. Early tests show that this is sufficient for current purposes.

Though no software effort was allocated to Observation Management since September 2004, the development code-named "Turtle" was released for evaluation by local scientists in Q4 2004. This is the mechanism that enables astronomers to characterize their observations as Scheduling Blocks; it uses the

Configuration API, Observing API, and Balancing API, to execute the observation. It was discovered in Q1 that because no effort had been dedicated to training the staff scientists one-on-one, to supplement the extensive online documentation available, that adoption of the tools by staff scientists was lagging. Adoption by the local staff is a prerequisite to transferring the technology to visiting observers.

Because of shifted priorities and resource allocations in Q2 2005, a resource has been made available for training, problem resolution, and related assistance. Now that this process has been formalized, the scientific staff will be able to work with the software and collectively determine when to require visiting observers to build GBT observations using Scheduling Blocks.

Data Handling Improvements

This project covers all aspects of observer-facing software that are encountered after an observation is successfully made, from data quality assessment and quick look capabilities through imaging. Work during Q1 2005 focused on expanding the scientific functionality of the modules, which included entrainment of modules from Tom Bania's work, Arecibo, and others. The IDL development process is being used as a means to generate a draft GBT Science Data Model (SDM), as well as the long-term vision of Python-wrapped C and C++ components compatible with an Observatory-wide framework. The by-product is a package for offline spectral line data reduction to support analysis of data from the majority of GBT's Standard Observing Modes.

Progress throughout Q1 relied on interactions with the Project Scientist, internal beta testers, and the external reviewers who have contributed their time and comments continuously since Fall 2004. Some highlights from the work completed in Q1:

- All minor milestones in Q1 were met: Tom Bania, Tim Robishaw, and Phil Jewell all previewed the GBTIDL work in development on schedule. They performed exploratory data analysis from which many useful comments were generated; these helped to guide development work during the quarter.
- The I/O functional layer is now rather solid. Searching and navigating complicated data sets through our indices is essentially complete.
- We are now using the same velocity algorithms as Arecibo.
- The package now includes versatile algorithms like interactive Gaussian and Baseline fitting.
- We now have calibration routines for almost all of the typical data-taking techniques for the GBT. These routines have been written with the expectation that observers will use them as templates for their own calibration routines.
- User documentation continues to be updated incrementally since we consider documentation an essential part of the project. A fair fraction of the documentation is automatically generated for us as part of the coding process by an IDL-based method.

- There have been significant plotter improvements, including converting to a plotter that is independent of the default IDL plotter. An independent plotter means that experienced IDL users still have access to the standard plotter for their own purposes.
- In comparison to the native facilities in IDL, we now have a way to generate hard copies of plotted data that is transparent to the user and represents far better the look of the plotted data.
- A new mechanism for storing data within a session, between sessions, and sharing data between packages was implemented. It is very similar to the NSAVE functionality in Unipops.
- Data selection capabilities were expanded significantly.
- Ways to combine data from multiple observing sessions were explored and implemented.
- Handling of IFs and spectral windows was made robust, so that the observer can straightforwardly access each class of data observed.
- Benchmarking and performance tests were done to ensure that the released product provides the optimal combination of generality and speed.
- Several other recommended usability enhancements were made.

Because complete SDFITS files will be required for users of the new IDL modules, work on SDFITS known issues was also completed in Q1 and SDFITSv1.2 was released on March 30. Scrolling status messages were eliminated during processing, the incorrect sign on the SITELONG keyword was corrected, the EXPOSURE column was corrected to account for blanking time, LST columns now accurately represent the integration midpoint, the type of SIG and CAL columns was changed to 1A, the INSTRUME keyword now correctly reports the backend, and the EQUINOX and DURATION columns were added.

Continued development in Q2 prior to the release will address topics such as real-time access to data, making the system more friendly for IDL novices, implementing more versatile ways of working with and plotting the data, and building quick reference documentation and training programs. The team is working towards providing a preview of the package to GBT support astronomers by the time of the Software Review on May 3, so that they will be prepared to transition the package to visiting observers shortly after the release. The month of June is dedicated to training and fixing any issues that are uncovered as more users explore their GBT data with GBTIDL.

Since the development of the gap analysis and project plan in December 2004, the team has remained on or slightly ahead of schedule for an anticipated end of May release of GBTIDL. Work during Q2 2005 will be focused on ensuring a successful release, and supporting technology transfer to visiting astronomer by the end of the period. After this, work will transition to more long-term concerns, such as requirements for the science data model and export data format for continuum data. Additional plans for 2005 include augmenting the quick-look display with spectral line results, and fully exploring the questions of data flagging and imaging for GBT data.

Green Bank Telescope

Penn Array Receiver

In the first quarter the second and third stage squid multiplexors for two columns were demonstrated to work and have good dynamic range in the Penn dewar. Some problems in the biasing electronics were identified and addressed. Goddard's detector test dewar failed, and problems were also encountered with absorber (bismuth) coated trial detector arrays. The dewar situation has been redressed, and the problem with the absorber coating traced to stresses applied by the passivization layer which is applied over the absorber and which change the transition temperature of the TES's. Detector development on this front continues. Some final touches were also incorporated into the dewar such as a more robust magnetic shielding enclosure can. GB wrote and successfully tested an interface between the NASA IRC data acquisition software and the GBT control system. Debugging of the NASA IRC software continues to proceed, but has been slowed because the only team member working full time on the IRC data acquisition software at GSFC has transferred most of his effort to another project for lack of internal funds. A test run of the Penn Array on the GBT originally scheduled for spring has been cancelled due to lack of convergence on a number of fronts (principally detectors, MUX electronics, and DAQ software). An engineering run is scheduled for fall/winter 2005/2006, with further commissioning in fall/winter 2006/2007.

New Receivers and Backends

Q1 saw more thorough characterization of the Ka-Band receiver's continuum capabilities, in preparation for commissioning and science with the Caltech Continuum Backend, and early spectral line science with this receiver. Work on the Caltech Continuum Backend proceeded and several significant milestones were achieved, including: completion of the daughter card layout, completion of the master card schematic, and completion of the first version of the FPGA firmware in full (now undergoing testing and refinement via simulation). Assembly and testing of the CCB is scheduled for the summer and early fall, with commissioning over the winter.

Spectrometer Upgrades

Considerable time was spent over the Q1 2005 in maintaining the current system. The primary problem encountered was failures in the LTA distribution cards which resulted in an unacceptably large number of lag 'drop-outs'. This problem was further exacerbated by problems with the test computer and monitor and the test fixture. The spectrometer is now up and running but without any spare LTA cards.

Work on the new LTA distribution cards continued. The first card has been manufactured, but problems with short-circuiting on the board were found, delaying the introduction of this card into the spectrometer. The card should be installed in Q2 2005.

The cross-polarization test fixture is now almost complete, with a projected completion date in Q2 2005.

Green Bank Telescope

The Spectrometer Spigot continues to be used for many projects, by several different groups, and to generate many tera-bytes of data! Significant improvements have been made in how to setup and configure the Spectrometer+Spigot, and these are being used by all of the Spigot observers. Additional improvements (including automatically generating "correct" FITs headers and much improved integration with astrid) are in progress. The vast majority of science is being done with the "stable" 16-bit modes. Migration to 8-, 4-, and possibly even 2-bit modes will demand significant improvements in the control of the input power levels. We are currently working this.

Very Large Array and Very Long Baseline Array

Very Large Array (VLA) Highlights

The venerable VLA control computers were moved to a new location in mid-February, to remodel their previous location into a new shielded room for the EVLA correlator. This relocation was carried out during an antenna move period, and took place with no loss of scheduled observing time.

VLA downtime for the first three months of 2004 was 9.4% of scheduled antenna hours. Most of this was caused by two antennas being out for EVLA outfitting; the downtime due to other causes was well under 2.5%, far better than historical averages. Thus, most astronomers had the maximum number of 25 antennas available during their scientific observations.

All VLA archival data have been transported to the National Center for Supercomputing Applications (NCSA), and the daily VLA data files now are transported to the NCSA via the Internet. We have begun a trial program of imaging a small subset of data from the VLA archive to assess the resources required for a more complete program to generate and provide calibrated images from the historical VLA archive.

Reviews were held for two user instrumentation proposals for the VLA. The Smithsonian Astrophysical Observatory proposes to instrument the VLA at 190 MHz with receivers intended to study the Epoch of Reionization. After a successful review, the first test receiver was installed during the quarter, and initial tests showed very strong radio frequency interference at critical frequencies. The Southwest Consortium proposes to build a demonstrator station for the Long Wavelength Array (20 to 88 MHz) on the VLA site, and connect it to the VLA. This review, held late in the quarter, was perceived to be successful, and further discussions about implementation will be held during the second quarter.

Very Large Array and Very Long Baseline Array

Very Large Baseline Array (VLBA) Highlights

Eight VLBA stations successfully supported the descent of the Huygens Probe into the atmosphere of Titan. Processing is being done at the Joint Institute for VLBI in Europe, to recover detailed astrometric observables that will be used to infer the properties of the wind in Titan's atmosphere.

A draft management plan for operational support of NASA spacecraft navigation was completed and submitted to NASA. Unfortunately, this coincided with budget cuts approaching 10% in the Science Mission Directorate at NASA, and the operational development program has been put on hold.

The maser clock at the Owens Valley VLBA station was removed, and replaced by another repaired maser; another maser was delivered to the original manufacturer for repair. A new power system was devised to keep the masers powered up by the vehicle during ground transport to VLBA stations, enabling reduced transport time and costs.

Preparations were made for an extensive maintenance visit to the St. Croix VLBA site early in the 2nd quarter. Because of its location, the St. Croix antenna always has been extremely susceptible to rust. At present, part of a quadrupod leg actually has rusted through, necessitating the addition of a St. Croix maintenance visit to fix the rust and other problems. An ongoing issue with the performance of the subreflector positioning system also will be addressed.

Management and Scientific Milestones

Milestones	Original Date	Revised Date	Date Completed
Complete COSMOS Large Project on VLA	01/09/05		01/09/05
VLBA Huygens Probe Tracking Experiment	01/14/05		01/14/05
AIPS++ Stable Release 10	01/15/05		01/15/05
VLA/VLBA General Proposal Deadline	02/01/05		02/01/05
Management Plan for Future S/C Navigation	02/28/05		02/14/05
Mark 5 Redeployment after Huygens Experiment	02/15/05		02/15/05
Move VLA control computers to new location	02/17/05		02/17/05
AIPS++ Stable Release 11	03/15/05	04/01/05	
VLA Public Tours	04/02/05		

Very Large Array and Very Long Baseline Array

Milestones	Original Date	Revised Date	Date Completed
Completion of VLSS Survey on VLA	04/07/05		
Global 3 mm VLBI Session	04/21/05		
Rust Repairs Completed at St. Croix	04/22/05		
New Proposal Tool Released for GBT	05/01/05		
AIPS++ Stable Release 12	05/15/05		
Assess Proposal Evaluation Method for Hi-redshift	02/28/05	05/25/05	
VLA/EVLA Transition Operations Plan, Version 1	05/27/05		
VLA/VLBA Proposal Deadline; VLA Large Proposals	06/01/05		
Complete Global cm VLBI Session	06/20/05		
Three VLBA Stations to Mark 5 Full Time	12/15/04	06/30/05	
AIPS++ Stable Release 13	07/15/05		
World Year of Physics VLA Tours	07/16/05		
Trial Proposal Tool Released for VLA and VLBA	05/01/05	09/01/05	
AIPS++ Stable Release 14	09/15/05		
Completion of Dwarf Galaxies Large VLA Project	09/26/05		
Completion of Virgo HI Large Project on VLA	09/26/05		
VLA/VLBA Proposal Deadline	10/01/05		
VLA Public Tours	10/08/05		
AIPS 31DEC05 Frozen; 31DEC06 Released	12/31/05		
Full Proposal Tool Release for VLA and VLBA	09/01/05	01/05/06	

Computer Infrastructure Milestones

Milestones	Original Date	Revised Date	Date Completed
Examine LDAP support (2)	08/31/04		01/31/05
Examine Redhat Enterprise support	12/31/04	01/31/05	03/01/05
Enable VoIP EVLA/AOC phones	04/15/05		
Outfit 3rd EVLA antenna network (1)	01/30/05	04/30/05	
Develop NRAO/AOC Computing Infrastructure Long	05/01/05		
Assist with and attend PeopleSoft training	05/15/05		
Examine OS/X support (3)	09/30/04	07/30/05	
Replace approx 80 older systems	07/31/05		

Milestones	Original Date	Revised Date	Date Completed
Expand archive to full capacity of 30TB from 17TB	08/31/05		
Migration to Windows 2K domain(4)	07/31/03	08/31/05	

(1) Waiting for antenna to leave the barn
(2) In progress. Project was redefined and rescheduled by CCE
(3) In progress. Date changed to reflect a broader scope of support
(4) In progress. About 60% complete, primarily waiting on hardware to replace older systems that won't run newer versions of Windows

Operations Software Support Milestones

Milestones	Original Date	Revised Date	Date Completed
Correlator controller bug fixes	03/31/03	02/15/05	02/15/05
Track program modifications for Mark 5	10/30/03	05/01/05	
Correlator controller transition plan	02/28/04	06/01/05	
Correlator controller operational	04/04/05	06/15/05	
Translate and copy stored VLA monitor data from 9-track to DAT	03/01/04	06/30/05	
Transcribe VLA observe/system files	11/30/02	01/01/06	

Electronics Milestones

Milestones	Original Date	Revised Date	Date Completed
Projects			
Support the Huygens Probe Observation	01/31/05		01/31/05
Determine the plan for a reliable WyeMon and WyeCom System for the VLA	06/03/05		
Maser Maintenance			
Remove Maser #13 from OV and install #3	02/28/05		01/24/05
Build an improved Maser transportation power supply	03/15/05		01/24/05
Deliver Maser #1 to Sigma-Tau for repair evaluation	03/18/05		03/04/05
Retrieve repaired Maser #1	11/11/05		
Receivers (FE)			
Install four 190MHz receivers on VLA antennas	05/31/05		

Very Large Array and Very Long Baseline Array

Milestones	Original Date	Revised Date	Date Completed
Improvements			
Upgrade the TAC and Servo Boards at KP	03/18/05		02/17/05
Upgrade the TAC and Servo Boards at SC	05/16/05		
Upgrade the TAC and Servo Boards at LA	10/15/05		
VLBA			
Install new elevation servo motor at OV	04/15/05		
Replace the dry air compressor at FD	04/25/05		
Complete maintenance visit and major overhaul at SC including FRM upgrade	06/09/05		
Replace the dry air compressor at SC	06/16/05		
Obtain sixty 2TB Mark5 modules	06/24/05		
Workshop for VLBA Site Technicians at AOC	08/09/05		

Engineering Services Milestones

Milestones	Original Date	Revised Date	Date Completed
Complete BnA array reconfiguration	01/21/05		01/19/05
Complete B array reconfiguration	02/18/05		02/17/05
Complete CnB array reconfiguration	06/17/05		
Site & Wye Group			
Complete track repairs between BN6-AN5	12/31/02	06/30/05*	

*Delay due to higher priority tasks such as intersection repair/replacement & tie replacement in areas that would render track unusable . North arm track is usable.

Interferometry Software Division

AIPS

Key Developments

1. Methods were developed in the previous quarter to allow for binary distribution of AIPS. In the first quarter of 2005, 19 sites downloaded the frozen 31DEC04 version and 76 sites downloaded the development 31DEC05 version of AIPS using this capability. So far, a total of 126 sites have downloaded 31DEC04, 294 sites have downloaded 31DEC05, and 364 sites have used the AIPS cvs code management facility. In all, 570 different sites (different IP addresses) appear in one or more of these lists.

2. Interactive tasks using Tektronix emulators have proved unreliable. Gaussian and baseline fitting tasks XGAUS and XBASL were revised to function with either the Tektronix emulator or the AIPS TV device. All Tektonix emulator functions now have alternative TV options.

3. Work on calibration source models was continued. A C-Band (6 cm) model for 3C48 was added to the AIPS distribution.

4. The 12-m telescope which used to be run by NRAO is still producing "on-the-fly" image data. The AIPS tasks to manage these data were revised to handle the current data from this telescope, which have the opposite byte order from the older data, as well as the older data.

5. Miscellaneous changes included correcting the complex Clean programs to handle modern file naming conventions, the bandpass calibration task to handle missing data better, and the calibration tasks to allow the user more control over robust solution methods. The memo on astrometric-level calibration with task ATMCA was released. The task which translates Clean boxes for changed cell size and facet location was corrected to handle simple cases and the DRAWBOX verb was enhanced to plot Clean boxes from such files.

Goals for the Second Quarter 2005

1. Continue user support and bug fixes, as the major portion of AIPS effort. Add the Intel compiler for Linux.

2. Add to the task which computes the fluxes of the primary flux calibration sources new (2004) flux values and interpolation in time between the tabulated values. Include additional user control and have the calibration tasks be more clever in their use of model images.

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.

AIPS++

The key activities for this cycle were the development for the SS10-SS11 releases, development and preparation for ALMA TST2.0 external user test, delivery of the monthly integrations of the Offline subsystem, delivery of Offline Release 2.1, and the migration to a standard/robust framework for use and development of the ALMA Science Data Model.

- SS10 *http://projectoffice.aips2.nrao.edu/ss10.html*

Very Large Array and Very Long Baseline Array

- SS11 *http://projectoffice.aips2.nrao.edu/ss11.html*

- SS12 Activity: *http://almasw.hq.eso.org/almasw/bin/view/OFFLINE/CurrentActivity*

- ALMA TST2.0 - All needed information on testing goals, data sets, code installation, etc
  Pre-testing commenced: 2/2005; concluded 3/2005.
  Deployment scheduled: 4/2005
  http://projectoffice.aips2.nrao.edu/almatst2.0/ALMA_TST2.0.html

- EVLA TST1.0 - All needed information on testing goals, data sets, code installation, etc.
  Pre-testing commenced: 3/2005
  Deployment scheduled: 5/2005
  http://projectoffice.aips2.nrao.edu/evlatst1.0/EVLA_TST1.0.html

- EVLA Planning - Merging requirements documents for EVLA/ALMA projects;

- Offline Subsystem deliverables for ALMA R2:
  http://almasw.hq.eso.org/almasw/bin/view/OFFLINE/R2.1 attach spreadsheet

Highlights:

- Complete re-factoring of the underlying framework for project-wide use of the ASDM. Complete support for C++, Java, XML, CORBA structs in manipulating the data.
- Discussions, documentation on a combined science data model for the EVLA and ALMA.
- Viewer performance profiling; resolution of key defects in visualization.
- Refactoring of DataCapture to new ASDM; communication and support o dependent subsystems on changes.
- History information available in all synthesis tools. Reviewed by NAUG.
- Facilities for uv-plane combination of single dish and synthesis data (using images or data cubes).
- Incremental calibration facilities.
- Prototype glish-less viewer.
- Preparation and pre-testing for ALMA TST2.0 (3rd test)
- Preparation and pre-testing for EVLA TST1.0
- Deployment of table-plot tool, a generalized interactive editing facility for data, calibration solutions, etc.
- Implementation of the NAUG-approved MS-selection rules (to be implemented at user level next cycle).
- Expansion of regression testing of end-to-end datasets. Include basic benchmark and data processing rate; add additional data sets.
- *https://wiki.nrao.edu/bin/view/ISD/RegressionTests*

Very Large Array and Very Long Baseline Array

Goals for the Second Quarter 2005

1. Execution of third ALMA external science test; scientific analysis focus on single dish/synthesis data combination.
2. Pre-testing for the first EVLA science test (EVLA TST1.0); scientific analysis focus on wide field imaging case.
3. Revisions to the ALMA Science Data Model (this incorporates support for EVLA and will be a shared SDM); revision of calibration tables. Development of the calibration data base.
4. Evolution of DataCapture
5. Implementation of the Filler process V1.0 (from the ALMA archive and from disk).
6. 3-year integrated planning for ALMA and EVLA (development, resources).
7. SS12 Development cycle
8. Simulation facilities for ALMA.
9. ALMA CDR3

Archive

The NRAO Data Archive has been operational since October 15, 2003 and allows everyone on-line access to all VLA data and some VLBA data (*http://archive.nrao.edu/archive*). To date, over 640 users from 240 institutions have downloaded over 2.0 Tbyte of telescope data. The download data rate is about 100 Gbytes per month. Data files over one year old are in the public domain and accounted for 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 June 2002, and some calibrated VLBA data going back to December 2002. Efforts to expand the VLBA archive back to 1992 are underway. There is a small amount of GBT data available now from 2003 and 2004.

We are in the process of constructing and loading an archive mirror-site at the National Center for Supercomputing Applications (NCSA). Thus far all VLA archival data have been transported to NCSA, and the daily VLA data files are transmitted to the NCSA via the internet. We intend to offer data download services from the NCSA in the very near future. This will take advantage of the NCSA high internet bandwidth and relieve the internet congestion at the Socorro-AOC.

An NRAO Virtual Observatory Plan has been written by Doug Tody and near-term, mid-term and far-term goals have been identified. In the near-term we will identify and select processed data products to include in the archive and make available through VO services. In the beginning, these data products will mostly consist of images from NRAO surveys and large proposed observing projects. We expect to make significant progress on making image data available to the VO within the next 6 months.

Very Large Array and Very Long Baseline Array

Proposal Tool

The goal of this project is to create an NRAO-wide proposal submission tool which initially focuses on the GBT. The tool, however, has been designed from the start such that adding support for other telescopes in the future will be relatively straightforward.

Our original intent to have the tool ready for the October 2004 GBT deadline was overly optimistic; we clearly underestimated the rate of convergence of the release/testing sequence, the difficulty in coming to an agreement on details of the instrument-dependent page, and the complexity of implementing a user database that has to work with a number of different applications.

During the first quarter of 2005 work focused on three areas. First, in the proposal tool itself the GBT resource page was finalized and several releases, each followed by a period of intensive testing by GBT scientists, took place. Second, the design of the user database was finalized and implemented, and third, the proposal tool and the user database were fully integrated.

In April 2005 we intend to have a final period of testing by external (non-NRAO) GBT users. Given the progress shown in the first quarter of 2005 we are still on target to deliver a working proposal tool, fully integrated with a user database, in time for the June 1 GBT proposal deadline.

Virtual Observatory

NRAO is a partner in both the US National Virtual Observatory (NVO) and in the International Virtual Observatory Alliance (IVOA). NRAO is active in VO development on three fronts: 1) participation in development of the international VO framework (e.g., science data access and FITS standards development); 2) providing radio data and services to the VO; and 3) coordination of NRAO data management and science data post-processing development with the standards and technology being developed by the VO community.

Development of the US NVO has been under way now for three years. A first version of the VO infrastructure, including a global resource registry and data access services, is now functional. A first round of NVO applications were released and demonstrated to the user community at the AAS in January 2005. NVO is currently in transition from a period of initial development to an operational mode. Development of the infrastructure will continue, e.g., adding support for authentication, asynchronous services, an advanced query language, large scale correlations, distributed workflows, and more sophisticated data models and data characterization standards.

A comprehensive NRAO VO plan has been prepared and was submitted to the Director's Office at the end of March. A key element of the plan is the development of a capability to publish user-generated science data products to the VO. The NRAO archive infrastructure would be enhanced to provide a project view including all raw and processed data products for an observing project. Standard

VO services would be implemented to provide access to catalog, image, spectral, and time series data products. Included is an effort to experiment with the generation of reference images for a subset of the observational data in the VLA archive. The VLA archive imaging pilot project will produce images for continuum data for the VLA B configuration at 5 and 8.4 GHz.

The annual NVO Advisory Committee meeting was held at the San Diego Supercomputer Center in January. D. Tody reported on the data access layer (DAL), including the VO data access services and plans for integration of data analysis software with VO.

Development of the VO Simple Spectral Access interface (SSA) continues. V0.9 should be out in time for discussion at the NVO team meeting in April. Within the IVOA DAL working group we have begun to look at how to interface 3D data (such as spectral data cubes, or IFU and MOS data) to the VO. This is being coordinated with the Euro3D effort. A subgroup of DAL has been formed to specify an interface for accessing spectral line lists. An updated specification for the Simple Image Access (SIA) metadata extension mechanism has been prepared, and is being prototyped in several services being implemented at the CADC and the CDS in Strasbourg. The Characterization data model, required to physically characterize data in the DAL services, is nearing completion. The proposed component-framework architecture for data analysis, developed in collaboration with OPTICON in a workshop held at ESO last December, was discussed within the NVO and IVOA at the AAS and at an IVOA executive committee meeting in San Diego in January. The architecture was adopted as the basis for further design within the OPTICON group at the end of January. Within NRAO, related prototypes are underway in the SSG and AIPS groups. Technical discussions this past quarter have focused mainly on the component container architecture and the communications and messaging infrastructure.

Preparation is under way for the upcoming spring IVOA workshop to be held in Kyoto in May, and for the second annual NVO summer school to be held in Aspen in September.

E2E Coordination

E2E is an NRAO-wide effort to develop a modern end-to-end dataflow system for all NRAO telescopes. This is primarily a coordination activity, with most actual development taking place within the telescope construction projects.

Several members of the ALMA team from Europe visited Socorro in the latter half of January. Coordinated meetings with EVLA were held to discuss proposal submission and observation preparation, a joint science data model for interferometric data (for ALMA, EVLA, and VLBA), the project model, data capture, and the computational framework project being advanced as part of data analysis and VO.

Very Large Array and Very Long Baseline Array

An E2E mini-review of the proposed EVLA communications infrastructure was held in February. Investigation of technical options continues and a revised design is in preparation. A more comprehensive effort to design the E2E portion of EVLA is planned.

Considerable effort and discussion has gone into specifying a development cluster for science data processing in Socorro. The Cray XD1 and various commodity Beowulf clusters were evaluated. Technical issues focused on the need for a high speed interconnect such as Infiniband, and the design of a high performance cluster i/o subsystem.

A second review of GBT software is planned for May 3 in Green Bank.

Central Development Laboratory

Central Development Laboratory Highlights

A new balanced low-noise amplifier for 2-4 GHz has been designed and built, and two units have been delivered to the EVLA for receiver prototyping. A second 211-275 GHz cartridge for ALMA has been completed and awaits testing. The first 211-275 GHz ALMA cartridge was successfully tested with the prototype IF switch. Plans were made for testing the first 211-275 GHz cartridge in the first production ALMA dewar to get a head start on front end integration. The performance on the new L-Band feed for the EVLA is now understood from the theoretical perspective. Nearly half of the first quadrant of the ALMA correlator has been checked out. ALMA first local oscillators were delivered for Bands 3, 6, and 7. The LO for Band 9 meets specification over 80% of the required frequency range and development continues. Regular observations of the sun at 20-70 MHz continue, and work is proceeding on extending the frequency range.

Major Developments

Milestones	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		
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	4-01-05	
Superconducting Millimeter-Wave Mixer Development:			
Test Band 6 cartridge with production LO and bias supply	07-30-04	02-28-05	02-28-05
Electromagnetic Support:			
Design of EVLA Ku-Band feed	09-30-04	06-30-05	
EVLA C-Band analysis	03-31-05		03-31-05
EVLA S-Band analysis	03-31-05	06-30-05	
Testing EVLA X-Band prototype feed horn	12-31-04	06-30-05	
ALMA Correlator:			
Support system testing at the AOC as far as the correlator is concerned	03-31-04		
Continue to receive and test production circuit cards	09-30-04		
Finish motherboard PCB layout of a modified SCC test fixture	12-31-04	05-01-05	

Milestones	Original Date	Revised Date	Date Completed
Populate and test at least 4 more first quadrant racks of the ALMA correlator	03-31-05	05-27-05	
Revise station card FPGA personalities to support the new TFB card	03-31-05	04-29-05	
Start testing of the first production TFB card in the first quadrant	03-31-05	07-29-05	
Complete final adder PCB layout	03-31-05		03-15-05
Install final clock distribution cards in the first quadrant of the ALMA correlator	03-31-05	07-29-05	
ALMA Frequency Multipliers:			
Band 7:			
First batch of 13 units delivered to NRAO (Subsequently, 13 units every 15 days until all of the 139 units are delivered)	07-31-04		(2 units pending)
Band 9:			
Prototyping complete. 3 units available for evaluation	09-15-04	03-01-05	03-01-05
GB/SRBS Phase II:			
70-300 MHz, dual polarization, log-periodic on 45-foot telescope, new analog spectrometer	03-31-05	06-30-05	
300-1050 MHz, dual polarization, 45-foot telescope with log-periodic feed, new analog spectrometer	02-28-05	04-29-05	
GB/SRBS Phase III:			
10-80 MHz, dual polarization, four crossed dipoles, new digital spectrometer	09-30-05	12-30-05	
80-300 MHz, dual polarization, log-periodic on 45-foot telescope, new digital spectrometer	09-30-05	12-30-05	
300-2500 MHz, dual polarization, 45-foot telescope with log-periodic feed, new digital spectrometer	09-30-05	12-30-05	

Amplifier Design and Development

A prototype 2-4 GHz balanced amplifier, employing Cryo-3 4200 devices in the first stage and medium power, low-noise FHX45X devices in the second stage, was built, debugged, and evaluated. Two more 2-4 GHz amplifiers with very repeatable performance were built and delivered to the AOC. Some improvements (a new substrate) were made to the previously reported 1-2 GHz balanced low-noise design to allow for more repeatable performance. Two low-noise 1-2 GHz amplifiers were built with new substrates and evaluated. The AutoCAD files for 1-2 GHz balanced amplifiers, both low-noise and high-power, and also the 2-4 GHz balanced amplifiers were updated.

These three new designs developed over the course of last year are now at the manufacturing stage. The electrical design of the 4-8 GHz amplifier has been finished and mechanical design will commence soon.

Amplifier Production

A total of 20 amplifiers were either produced or reworked during the quarter. In addition to the 1-2 and 2-4 GHz amplifiers reported above, new production included two K-Band and three Q-Band LNAs. The remaining amplifier activity involved various Cryo-3 upgrades and other repairs.

The Chemistry Lab received 16 new body/flange sets for K-Band LNA production, all of which received final preparation and gold plating. Problems with the electroforming have been largely resolved, and limited production has resumed.

Superconducting Millimeter-Wave Mixer Development

ALMA Receiver Development

SIS wafer production: Last quarter, we reported an impending crisis caused by the absence of continued funding for superconducting circuit development at the University of Virginia Microfabrication Laboratory (UVML), fabricator of the SIS mixers for ALMA Bands 3 and 6. Without NRAO support, it was likely that critical UVML staff would leave for other universities before completion of the ALMA wafers. The crisis has been averted by NRAO's decision to continue support for SIS mixer development at UVML. The focus will be on development of technology for a 350-μm SIS receiver (see below). During this quarter, we received three Band 6 wafers from UVML. They are currently being evaluated.

Band 6 mixer-preamps: Out of a total of 14 mixer/preamps tested this quarter, three were considered cartridge-ready. Note that a mixer is deemed acceptable only after being tested twice, once with a standard pair of IF preamplifiers and then with a final pair. Testing with the standard preamplifiers is necessary for wafer evaluation in the absence of the wafer test set originally planned for this work but delayed for budgetary reasons. As part of wafer evaluation, mixers with different tuning circuits (there are four on a wafer) are measured to enable the best circuit to be selected.

4-12 GHz preamplifier production: Following a January visit to ACC by one of our technicians, preamps made by ACC have begun meeting specifications. We have received one batch of five from ACC this quarter, and ten remain in the current order. Our production amplifier test system is almost ready for routine operation. Problems with nonlinearities in amplifiers and detectors have been solved, but there are still some bugs to be eliminated. While there is still no formal agreement between NRAO

and JPL for access to HFETs from the Cryo-3 wafer, progress is being made. In the meantime, we are able to get sample quantities of the transistors sufficient to finish the first production run of amplifiers at ACC.

Orthomode transducers: The transfer of the OMT project for Bands 3 and 6 from Tucson to Charlottesville is now complete. VNA measurements can now be made at room temperature, but the liquid helium test set is not yet operational, and thus we lack a complete understanding of the OMT performance at the working temperature.

Band 6 cartridges: The second cartridge (excluding a functioning prototype) has been assembled and is ready for testing. We have almost completed the final round of design modifications before proceeding with production of the remaining cartridges in the first group of eight. Modifications have been made to the IF cabling to simplify cartridge assembly and disassembly. In the LO waveguide assembly, it was found that the waveguide bends had 0.4 dB excess loss, which was eliminated by thorough cleaning. Some of the overmoded stainless-steel waveguides between the LO tripler and the mixer were found to have sharp suckouts caused by gaps in the waveguide-to-flange silver solder joint. The flaw could not be detected by VNA measurements in the fundamental band of the waveguide. Suspected leaks in the LO waveguide vacuum windows were finally attributed to be the basic leak rate of the o-rings (~$3x10^{-8}$ std cc/sec.). It was found that leak tests using a He mass spectrometer must be done over a period of 1-2 hours to allow time for the helium to diffuse through the o-rings.

Band 6 cartridge test system: Cartridge beam pattern measurements continued this quarter in an attempt to determine the origin of a sidelobe on one side of the cartridge beam. It appears that the sidelobe is caused by interaction between the infrared filters and vacuum window in the cartridge test dewar. A fully-motorized scanner is being designed to replace the semi-manual system now in use for beam pattern measurements in the cartridge test system. A frame was designed to enable the existing beam scanner, chopper, and LN_2 cold load to be mounted above the ALMA receiver dewar for beam pattern measurements of complete receivers in the integration center.

LO power amplifiers: The design of LO power amplifiers for Band 4 and Band 8 is well under way. These are expected to deliver over 100 mW of power to the final multiplication stages at 65-80 GHz and 75-100 GHz. They will be fabricated at Northrop Grumman Space Technology (NGST) in their 2-mil 0.1-μm GaAs pHEMT MMIC process by the end of 2005.

Non-ALMA Millimeter-Wave Development

350-μm receiver technology development: The proposal to develop technology for a heterodyne receiver in this band has been approved by the Director. There are two important reasons for undertaking this work: (i) success in this work will put NRAO in a strong position to bid on the ALMA Band 10 receiver production; (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 operation phase in about three years when there are expected to be funds available to support further receiver development.

385-500 GHz SIS mixer: This is a joint project between NRAO and the University of Virginia Microfabrication Laboratory (UVML) and is supported mainly by UVML through an NSF grant. The mask set for the mixer is being fabricated by e-beam lithography at a commercial mask manufacturer. The junction fabrication process is being optimized at UVML. Design of the mixer block is under way. In the current 585 GHz HEB mixer block, the mixer chip's IF/DC beam lead is attached directly to the center pin of a K-connector using conductive epoxy. Although this provides a good electrical connection to the mixer circuit, it is difficult, after the epoxy is cured, to remove the mixer chip from the block non-destructively. We are currently investigating alternative, more flexible ways to make the IF/DC connection.

Investigation of Beam Lead HEB Mixers for Heterodyne THz Biohazard Detection

This SGER (Small Grant for Exploratory Research) was awarded by the NSF under the ACT (Approaches to Combat Terrorism) program. This was a one-year program (officially ended in September 2004) to build, measure, and compare different types of beam lead HEB mixers in a 600-720 GHz receiver using existing NRAO equipment. Although HEB mixers are not competitive in noise temperature with Nb-based SIS mixers in this frequency range, performing experiments here is a convenient and inexpensive way to gain insight into the fundamental workings of HEB mixers in preparation for work at higher frequencies.

The NbN phonon-cooled HEB mixer tested last year was tested again with improved optics. This lowered both the conversion loss and noise temperature, as shown in Fig. 1. The receiver is currently being modified for a lower (1-2 GHz) IF. This is to investigate the IF response of this mixer, as this has been one of the major challenges in using HEB mixers.

An undergraduate summer student will be working on this project this summer with the goal of measuring receiver noise at different IFs and possibly upgrading the receiver to measure a 1.5-THz HEB mixer. A paper was submitted to the IRMMW-THz Symposium entitled "Receiver Measurements of pHEB Beam Lead Mixers on 3-μm Silicon."

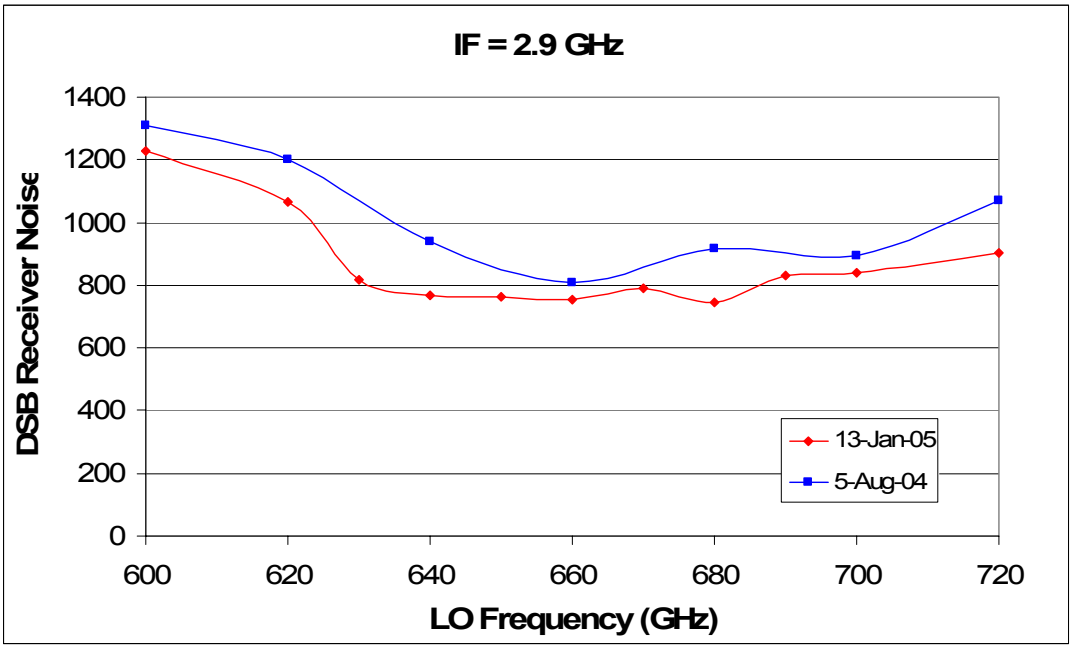

Figure 1. Measured DSB receiver noise of NbN pHEB mixer. 5-Aug-04 measurements were made with out-of-focus optics. 13-Jan-05 measurements were made with improved optics.

Electromagnetic Support

EVLA

Aperture efficiency and spillover temperature of the VLA antenna were computed at C-Band (4-6 GHz) using measured far-field patterns of the feed. The efficiency varied between 0.55 and 0.65.

Measured results of the L-Band, C-Band and Ka-Band feeds were presented at the Critical Design Review meeting held in Socorro, NM on February 17, 2005.

With the S-Band feed being a scaled version of the C-Band feed, measured C-Band feed patterns were used to calculate the efficiency and spillover temperature of the antenna at S-Band. At 20° elevation of the antenna, spillover temperature varies between 23 K and 10.5 K in the 2-4 GHz range. A linear taper horn with dimensions the same as the profile horn was analyzed for performance comparison. This horn results in about 1 K lower spillover at 2.5 GHz and almost 3 K lower at 4 GHz compared to the profile horn at 20° elevation. Aperture efficiency for the two feeds is about the same.

Central Development Laboratory

Spectrometers/Correlators

ALMA Correlator

During the last quarter, construction and testing of the first quadrant of the ALMA correlator continued. Assembly of all eight racks of the first quadrant is now complete. The first four racks, assembled during the last quarter, have been used throughout this quarter for system testing, for planning in preparation for system verification of the tunable filter bank card, and for software development.

Over 300 assembled production circuit cards of various types for the correlator were received and most were successfully tested during the quarter.

Four assembled DTS receiver simulator cards were received and successfully tested both in a test fixture and in the first quadrant.

All production data port cards were received, and an order for the final adder cards was placed.

Enough clock distribution cards for the first quadrant were assembled and installed into the system. One of the integrated circuits on this card was found to be unusable for this application, and a replacement device was found and placed on order for evaluation. The original design is sufficient to allow continuation of system testing.

All signal cables for the full four-quadrant correlator were received during the quarter.

All station card FPGA personalities (programs) were re-designed for use with the tunable filter bank card and testing of the new personalities started in a test fixture.

The present schedule shows that the first quadrant of the correlator, capable of handling the output of up to 16 antennas, will be ready for shipment several months before the building is ready to receive it.

ALMA Frequency Multipliers

The purpose of this project is to develop millimeter- and submillimeter-wave frequency multipliers for use in laboratory experiments and receiver systems associated with ALMA. A series of multipliers using varactor and varistor circuits operating in the 50 to 950 GHz range are currently being developed and evaluated. The status of the cooled frequency multipliers for the various ALMA frequency bands in the baseline plan is described, followed by an outline of other frequency multiplier development efforts.

Central Development Laboratory

A brief summary of the activity in this quarter is given, and reference to detailed reports provided as appropriate.

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

Band 6 and Band 7: As reported earlier, Virginia Diodes, Inc. (VDI) had been awarded the contract to supply the frequency triplers to meet the full ALMA first LO requirement (all 64 antennae, plus 10% spare units). The progress was close to the mutually-agreed schedule that called for the order to be completed by the end of December 2004.

All of the units ordered for Band 6 and Band 7 (139 each) have been completed, tested and delivered by VDI. Subsequently, these have been accepted based on cryogenic evaluation of randomly selected units (2 units were evaluated per batch of about 13 units) at the NTC.

The units that were evaluated as part of the acceptance testing are available for use in the receiver cartridges, while the remaining units are undergoing cryogenic evaluation in the laboratory prior to being made available for use.

Band 9: As described in earlier reports, the Band 9 frequency quintupler development contract with VDI was modified to support the development of an integrated version of the frequency doubler-tripler cascade and the supply of three such units for use in the Band 9 LO instead. This was done after a cascade of frequency doubler followed by a frequency tripler driven by a Band 7 LO driver was evaluated at the NTC and yielded encouraging results as described in ALMA EDM document number FEND-40-10.00.00-027-A-REP.

Subsequently, three versions of the integrated Band 9 frequency sextuplers were supplied by VDI and evaluated at cryogenic temperatures at the NTC. While each of the units produced the desired output power over portions of the desired frequency band, none of them met the overall specifications since there were dropouts in output power at certain frequencies in the specified LO band. See ALMA EDM document number FEND-40-10.00.00-043-A-REP for further details. Two units corresponding to the best design were assembled and, after cryogenic evaluation, delivered to the Band 9 cartridge group for integration into the first cartridge. VDI is scheduled to deliver another pair of similar frequency sextuplers, the final deliverables for the current development contract.

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. The following approaches were selected since they have the minimum cost and schedule impact on the project. The dates provided for the scheduled completion of each approach is only indicative (they are based on amplifier development schedules, which is not the topic of this report) and should not be construed as a milestone.

1. Reverting back to the frequency quintupler: Measurements on the existing frequency quintupler blocks indicate that the 40 μW output power requirement could be met with an increased input drive level of 25 mW (requires 40 mW power amplifier output in the warm cartridge assembly, outside the dewar). This might be possible with the revised LSPA132 InP HEMT-based power amplifier design that is scheduled to be evaluated in the May–June 2005 time frame. Evaluation results of the amplifier itself, as well as the overall performance of the quintuplers driven by this amplifier, should be available by the end of July 2005.

2. An alternate drive source for the frequency quintupler could be a WR8x2 frequency doubler from VDI which could be pumped at a 200 mW level by a power amplifier (new design) producing 300 mW in the 61–71.2 GHz in the warm cartridge assembly (outside the dewar). The power amplifier should be available around the end of November 2005. Evaluation results of the amplifier itself, as well as the overall performance of the frequency doubler-quintupler chain driven by this amplifier, should be available by the end of March 2006.

3. Explore another level of power-combining in the power amplifiers for the integrated frequency sextupler: The existing power-combined amplifier power combines two individual amplifier chips per polarization/channel. The possibility of power-combining four chips per polarization/channel should be explored to achieve increased drive power level for the existing integrated frequency sextupler. Evaluation results of the amplifier itself, as well as the overall performance of the frequency sextuplers driven by this amplifier, should be available by the end of May 2005.

4. Two-frequency tripler cascade option: Without changing the drive requirements for the final tripler stage in the frequency sextupler, this approach would move the required input frequency range lower down in frequency where larger driver power could be achieved. However, existing frequency tripler data suggest that the efficiency loss in going from a frequency doubler to a frequency tripler would negate the benefit of improved input drive power. Consequently, such an approach could only be considered if the final frequency tripler were to be redesigned using a reduced-height barrier diode. But if that were done, the existing sextupler configuration would probably suffice as well. The move to the two-frequency tripler cascade would permit substitution of the more reliable GaAs-based power amplifiers instead of the InP-HEMT-based power amplifiers that have lifetime issues. These power amplifiers would need to be in the 67.8–79.1 GHz frequency which is very close to that of the Band 4 first LO driver output, for which the power amplifier is already being designed, and should be available for evaluation around the end of November 2005. The design of the AMC for such an option would mimic that being worked for the Band 4 Warm Cartridge Assembly (WCA) as well. Given these advantages, the progress with the development of the reduced-height, barrier-diode-based frequency tripler being pursued by VDI needs to be watched closely.

See ALMA EDM document numbers FEND-40-10.00.00-049-A-MEM and FEND-40-10.00.00-050-A-MIN for further details as well as additional discussions on these options.

Central Development Laboratory

ALMA LO Source

The purpose of this project is to develop 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.

One paper was submitted on this work to the 2005 IRMMW-THz Symposium entitled "Development of Electronically-Tuned Local Oscillators for ALMA." The two papers submitted on this work to the 2005 IEEE International Microwave Symposium last quarter were both accepted and will be presented at the conference in June.

New Active Multiplier Chain (AMC) and Power Amplifier (PA) modules for the Band 3 LO were designed and are being fabricated. They will be ready for delivery and retrofit in the next quarter. This is to implement a change request from this quarter to add independent power control in both channels of the Band 3 LO. AMC and PA modules for the Band 6 and 7 LOs are essentially in production mode, with assembly and testing being done by outside contractors in some cases.

The first Band 9 Warm Cartridge Assembly (WCA) was delivered. In combination with the delivered sextuplers, this LO provides the specified power over about 50% of the band. It is limited by the available power from the InP MMIC power amplifiers. A new version of the PA module, with another stage of waveguide power-combining, was even fabricated for the second WCA deliverable. This PA module uses ten PA MMICs and dissipates twice as much power and is, therefore, not a desirable final solution. In the next quarter, the primary focus will be finding a permanent solution for the Band 9 local oscillator. Modified InP MMIC PA designs for 120-144 GHz will be delivered from the foundry. If these are successful, they will be used to drive the VDI quintuplers, which are proven to provide sufficient output power when driven with at least 25 mW. If this approach is not successful, then work will focus on using higher-power GaAs PA MMICs, currently being designed, to drive either an x9 or x10 series of multipliers.

A post-doc, Chau-Ching Chiong, from the ASIAA Institute in Taiwan, has just arrived. He will be here for about 12 months, 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.

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 will be performed at the NRAO Technology Center (NTC) in Charlottesville. Solar activity continues to be monitored over the 20-70 MHz band by GB/SRBS Phase I with excellent reliability.

Progress on the upgrade has been slow due to shop delays. However, fabrication of all front-end hardware is now completed for the 70-350 MHz subsystem. The front-end hardware for the 300-2500 MHz subsystem should be fabricated during the next quarter. Real-time data access to the new sweep spectrometer has been implemented. Assembly of front-end components is progressing as quickly as possible with deployment on the 45-foot now projected for the end of April.

The prototype version of a 30-350 MHz RF board for use with the new digital spectrometer (Phase III) has been assembled and evaluated. The board is functioning properly with only minor changes required to improve reliability and reduce assembly time. A second iteration board was received.

Planning has begun for FASR-related component development using the GB/SRBS platform. Two target areas have been identified: (1) broadband, dual-polarization feeds with integrated amplifiers, and (2) low-frequency array element and clustering details.

Computing and Information Services

Computing and Information Services (CIS) Highlights

Computing and Information Services (CIS) personnel continued their efforts to provide robust computer and network security, providing increased user education and successfully managing the issues associated with the VPN (virtual private network (VPN) client software package that connects offsite systems to NRAO's internal network. Only a single computer security incident was reported this quarter, and it was rapidly resolved. The Observatory occupied its new Edgemont Road - Stone Hall facilities in Charlottesville this quarter. CIS staff went into high gear to re-wire the existing building. Significant effort was required to successfully re-locate employee computers and phones with minimal disruption and downtime to Observatory operations. Another significant milestone this past quarter was the CIS decision to upgrade the intranet backbone between Green Bank, Socorro, and Charlottesville from T1 to T3/DS3 service this summer.

Central Computing Services

Security

The focus for Security Committee activities in this quarter has been twofold: planning for increased levels of user education, and issues surrounding use of a proprietary VPN (virtual private network) client software package used to connect offsite systems to NRAO's internal network.

The plans for this calendar year on the user education front will include such activities as:

- An internal Web e-zine and associated monthly e-mail summary focussed strictly on Computer Security;
- A regular column in NRAO's existing "Point Source" newsletter for staff on the same topics.
- Focus via the CV "Computer Lunch" and other presentations on the issues surrounding protection of our staff's home computers. These are now the single most likely source of potential intrusions, viruses, and other malware injections.

Targets for these activities will be set after the Systems Administration Workshop in April 2005 in Charlottesville. However, a presentation on use of alternative browsers and mail clients such as Firefox and Thunderbird has already been given and was well received.

The VPN, and appropriate use of its client, continues to be discussed thoroughly among the Computer Security Committee members. A consensus—was achieved on the issue of access to the VPN client whereby it should be normally installed only on NRAO-owned hardware; how to achieve this goal is still an ongoing discussion. In the interim, the form mentioned in the following paragraph will serve as a stopgap measure.

Computing and Information Services

There was one reported computer security incident during the past quarter: a contractor inadvertently omitted to stop a peer-to-peer program running on his personal laptop computer while it was connected to NRAO's network. The issue was resolved less than an hour from the detection of the unwanted network traffic. A new CIS form has been created to mitigate against this and other problems. It requires anyone who wishes to connect to NRAO networks, either directly or via VPN or NRAO's modem pool, to agree to the NRAO Security and Use policies. We hope to have this form in use at all sites in the coming quarter.

Common Computing Environment (CCE)

Milestone	Original Deadline	Revised Deadline	Date Completed
Setup syslog service for Windows	02/11/05		02/11/05
Deploy syslog on remaining win servers	04/29/05		
Documentation for JD Edwards system	05/13/05		
GPO settings for remote access, DNS	02/11/05		03/22/05
Firewall rules for off-domain systems	04/22/05		
VPN documentation and configuration	03/01/05		03/30/05
Proposal for group rationalization	02/01/05		02/15/05
Decision on LDAP as replacement for NIS	04/26/05		
Identify services for LDAP retrofit	05/02/05		

Much of the effort and discussion in the Common Computing Environment project this quarter has focussed on planning for the annual Systems Administration workshop (dubbed “SysAdmin 2005”) to be held in Charlottesville April 20-22. The focus for this meeting will be on long-range planning, and we hope one of the products to emerge from the workshop will be a 5-year plan for NRAO's Computing Services.

The Windows administrators came to a consensus and implemented a method to allow Active Directory users to take advantage of Windows XP's “Remote Desktop” feature. Remote Desktop is a feature of Windows XP that allows a user to remotely log into their Windows machine and gain access to it's resources as if the user were actually at the console of that computer.

Security of the Windows XP computers has been increased with the implementation of the Windows Firewall. Three of our four sites are now enforceing the host-based firewall on workstations running Windows XP Service Pack 2.

Due to the availability of a dedicated network engineer in CV, it was finally possible to rationalize the configuration and documentation for the VPN concentrators (VPN = Virtual Private

Network, enables remote systems to join NRAO's internal network in a secure/encrypted manner). Additional functionality of the VPN concentrators continues to be tested but intrinsic problems therewith have prevented rollout of this web-based interface as a general service. We hope the vendor will produce a fix in a reasonable timescale.

A proposal to rationalize the currently fractured and inconsistent Unix group memberships has been created, and pending the outcome of the SysAdmin 2005 workshop, is expected to be implemented in the coming quarter.

Finally, while it remains to be determined if a consensus emerges from the workshop on deploying LDAP, some preliminary targets involving the replacement (or at least augmenting) of the Unix NIS (yellow pages) directory service with a full-blown LDAP based directory service have been added to the list above.

Web Infrastructure

Milestones	Original Date	Revised Date	Date Completed
Design of Next Generation Web Services	11/30/04	04/30/05	
Evaluate additional Groupware	04/01/04	06/30/05	
Purchase proxy servers for VLA	06/05/03	05/07/05	
Instant Messaging Server Pilot Project	12/31/04	06/30/05	
Deploy Next Generation Web Services	07/01/05		

There is little activity to report in this quarter. Due to time pressures and higher priorities in other areas, most of the individual targets were not addressed, or were deferred until after the System Administration Workshop.

Charlottesville Computing

While the construction work continued to dominate CV Computing Division activities, the light at the end of the tunnel finally became visible. With the occupancy certificate of the new building in hand, the rewiring of the old part of the building, and preparations to move computers, phones, etc. for many of the CV staff went into high gear.

The division took advantage of special pricing (≥50%) to purchase several server grade systems. These will be used in coming months for a variety of tasks, including upgrades of existing servers, provision of citrix service, possible anti-spam quarantine service, compile server for AIPS/AIPS++, etc.

The "castoffs" from the upgrade will be put to use also, likely including the pilot instant messaging server mentioned in the Web Infrastructure section.

Observatory-wide Communications

Milestones	Original Date	Revised Date	Date Completed
Deploy new Ethernet switch in Green Bank	04/30/05		
Deploy new Ethernet switch in Charlottesville	05/31/05		
Upgrade network services to VLBA SC antenna	09/30/04	05/31/05	
20 Mbps service between the major NRAO sites	08/31/05		

We have decided to upgrade the intranet backbone between the three major sites from T1 service to T3/DS3 service. This will provide better communication between the sites, including increased support for data and video traffic, and will provide greater access from Green Bank to the Internet and Internet2. At present, the sites have two or three T1 (1.5 Mbps) connections. When the new network is installed, we will have 20 Mbps available at each location. The goal was to have this ready for deployment in April. However, because of the remoteness of Green Bank, the service will probably not be available there until the end of July. The New Mexico Institute of Mining and Technology is also upgrading its network connection, and this impacts the speed with which the service can be fully deployed in Socorro. In the interim, we are pursing other options to enable enhanced service.

The major effort in communications has been the cabling of the addition of Stone Hall for networking and telephony. Wiring of the newly constructed areas is complete. Since the main communications room is in a different, more central location, all of the cabling from the existing rooms must be run to the new location. This is now complete on the second floor and partially on the third floor. Enough of this is complete that it will not delay the moving of the personnel from Old Ivy Commons in April. A completely new Ethernet switch will provide Local Area Network services to the whole building and provide increased capacity for additional video services. This should be available by the end of May 2005.

As a result of lower costs for our intranet contract with AT&T, we decided to upgrade the service to the St. Croix VLBA antenna. This has been delayed by the local company in the Virgin Islands, but it is now scheduled to be completed by AT&T next quarter.

The network of video teleconferencing units continues to be a fundamental resource for inter-site meetings. Additional units needed for the new conference rooms in Stone Hall have been ordered. Based on our experience, we will recommend the acquisitions of new units in Washington D. C. and Santiago, Chile to expedite communication for ALMA. We will also continue to investigate the deployment of equipment and software for use by individuals in their offices.

Computing and Information Services

It is clear that the Ethernet switches in Green Bank are becoming outdated and have reached their limit for expansion. Furthermore, we no longer have staff members who are conversant with the operating system on those switches. We have therefore begun funding a program to replace all of them with new Cisco switches, which will be more capable and more expandable. The initial new switch is now installed and in operation.

Education and Public Outreach

Education and Public Outreach (EPO) Highlights

Lee Shapiro resigned his position as Head of the EPO Division, effective March 1, 2005. Mark Adams (Assistant to the Director) will lead the EPO Division until a permanent replacement is hired by the Observatory. Andrea Gianopoulos joined the EPO staff in January as a Public Information Officer (PIO). The Observatory has also created an "EPO Scientist" role to provide scientific guidance for EPO programs; NRAO scientist Juan Uson has agreed to serve in this capacity. The Legacy Imagery Project continued to explore radio data visualization techniques and produced several compelling radio – optical composite images. The Science Museum Outreach program module that will deliver NRAO press releases to the more than fifty science museums and planetariums that subscribe to STScI's *ViewSpace* multimedia program will debut by June 1, 2005. EPO staff collaborated with scientists across the astronomical community to produce and distribute 10 press releases on a wide range of excellent science and Observatory news this quarter, including NRAO's key role in the Cassini-Huygens mission at Saturn. EPO distributed 4 press releases at the January AAS meeting, and NRAO scientific results were featured in two AAS press conferences. The NRAO and National Youth Science Foundation proposal to jointly operate the 2005 West Virginia Governor's School for Science and Mathematics (GSMS) was selected and awarded $115,000. Compared to Jan – Mar 04, visitation at the Green Bank Science Center increased slightly; visitation at the VLA Visitor Center decreased slightly. Gross revenues decreased at both centers. EPO and other Observatory staff participated in a wide range of community service activities this quarter, including mentoring, teaching in local schools, enrichment activities, special tours, science fair judging, and invited talks.

Overview

The second quarter of FY 2005 saw several important developments in the NRAO education and public outreach (EPO) program. NRAO staff have begun a *Legacy Imagery Project*, developing techniques to process radio astronomy data into compelling visual imagery; and a *Science Museum Outreach* initiative, producing programs about radio astronomy that incorporate high resolution imagery, movies, animations, captions, and music.

In January, Lee Shapiro resigned his position as Head of the EPO Division, effective March 1, 2005. Director K.Y. Lo asked Mark Adams (Assistant to the Director) to succeed Shapiro. Adams gained substantial EPO experience at the University of Texas (1994 – 2004), where his responsibilities included managing the McDonald Observatory Visitors Center and a twenty-person EPO staff.

Education and Public Outreach

Andrea Gianopoulos joined the NRAO EPO staff in January 2005 as a Charlottesville-based Public Information Officer (PIO), replacing Chuck Blue who accepted a position at the National Science Foundation. Ms. Gianopoulos brings many years of science writing and editing experience to the NRAO, including positions at *Astronomy* magazine and major freelance assignments for the *National Geographic*.

Another important recent EPO personnel development has been the creation of an "EPO Scientist" service role. The EPO Scientist is a member of the NRAO scientific staff whose Observatory service includes providing scientific oversight, input, assistance, and guidance for the programs and policies of the NRAO Education and Public Outreach Division, working closely with the EPO Division Head. NRAO scientist Juan Uson has agreed to serve as the Observatory's EPO Scientist.

An EPO planning meeting was convened by Adams in New Mexico on March 7 – 8, 2005 to review progress against the FY 2005 EPO Program Plan, to initiate planning for FY 2006, and to outline a long-range plan for EPO. This meeting was attended by EPO personnel from West Virginia (Sue Ann Heatherly, Cara Rose, Bill Saxton), New Mexico (Dave Finley, Robyn Harrison), and Virginia (Andrea Gianopoulos, Mark Adams). EPO Scientist Juan Uson and Graphic Artist Patricia Smiley participated via video-conference from Charlottesville. This meeting critically reviewed the objectives, schedules, deliverables, and accomplishments of each EPO program element described in the following sections.

EPO highlights for the January – March 2005 quarter are described in the following sections.

Legacy Imagery Project

The Legacy Imagery Project, an NRAO initiative to improve the Observatory's capability to process radio-wavelength astronomical data into compelling visual imagery, made good progress this quarter. EPO Scientist Juan Uson continued to explore radio data visualization techniques and has produced several impressive radio—optical composite images that will be excellent additions to the on-line Image Gallery and have been converted to posters. Uson has developed a draft recipe to assist NRAO users with the creation of such composite imagery (VLA Scientific Memo #178). The composite radio—optical image of the Whirlpool Galaxy (Messier 51) in Figure 1 was recently produced as a processing technique demonstration. The 21 cm radio data were acquired by Rots et al at the VLA (B and D configuration); the optical data are POSS-II images.

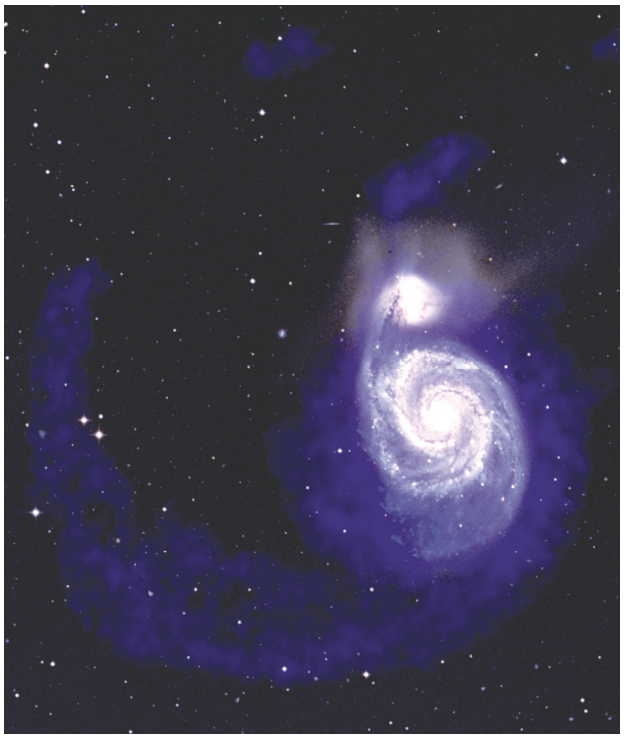

Figure 1 A radio - optical composite image of the Whirlpool Galaxy (M51) produced by the Legacy Imagery Project . The radio and optical data are, respectively, VLA and POSS-II.

Uson, Adams, and Smiley have also initiated the design and planning for an NRAO Radio Astronomy Image Contest which will be announced at the May 29 – June 2, 2005 American Astronomical Society meeting in Minneapolis. This image contest seeks to engage the astronomical community in the Observatory's efforts to increase the number of visually compelling, high-quality radio astronomy images available for education and public outreach. With prizes sponsored by AUI, this contest will result in the generation and submission of significant numbers of high-quality radio images to the NRAO. The Observatory plans this imagery contest as an annual event. Images submitted to this contest will be included in the NRAO Image Gallery and will be readily available for use by scientists, students, teachers, the general public, the media, and EPO professionals.

The NRAO Image Gallery is a valuable resource that has been on-line at the Observatory since 2002. The Legacy Imagery Project will greatly improve the Gallery's content, organization, and value to scientists, teachers, students, the general public, the media, and EPO professionals. Our long-term goal is to establish the NRAO Image Gallery as the international location of choice for persons seeking radio astronomy imagery.

Education and Public Outreach

Science Museum Outreach

EPO staff continued to develop a program of radio astronomy outreach to science museums and planetariums. As noted in previous Quarterly Reports, the Observatory's initial goals for this program will be accomplished through participation in *ViewSpace,* a free, readily-updated, multi-media electronic exhibit designed by the Space Telescope Science Institute (STScI) that is now available in more than fifty museums and planetariums (see *http://hubblesource.stsci.edu/exhibits/viewspace/*).

In February, NRAO EPO and Space Telescope Science Institute (STScI) Office of Public Outreach staff defined the process and responsibilities of each organization for program development. The resultant mutually beneficial agreement avoids duplication of effort and permits the NRAO to leverage STScI's technology and personnel investments in *ViewSpace*. The NRAO will capitalize on the *ViewSpace* network to distribute its programs to museums and planetariums and the infrastructure STScI has developed to provide content for *ViewSpace*. For each full-length program module, the NRAO will produce and deliver to STScI an annotated script and associated imagery. STScI personnel will generate the multimedia programs optimized for *ViewSpace.*

The first NRAO program being developed is a press release module. A draft template for this press release module has been completed and is expected to debut on *ViewSpace* by June 1, 2005. The second NRAO module, a full-length program on radio astronomy, is currently in the early phases of script production. Future NRAO program modules will feature ALMA and the EVLA. Since these *ViewSpace* program modules will be visually intensive, the image products by the Legacy Imagery Project will be a significant resource.

The Legacy Imagery Project also is expected to spur development of a traveling radio astronomy / NRAO exhibit. EPO is exploring, for example, developing partnerships with organizations such as the Smithsonian Institution Traveling Exhibit Service (SITES). SITES develops and distributes exhibits to schools, museums, libraries, science centers, historical societies, community centers, botanical gardens, and even shopping malls.

Media Relations

NRAO EPO staff collaborated with Observatory scientists and members of the external astronomical community to produce and distribute ten press releases this quarter on a wide range of excellent science and Observatory news. Each is available on-line at *http://www.nrao.edu/pr*.

One of this quarter's most exciting results was the Observatory's participation in NASA and ESA's Cassini – Huygens mission, an excellent example of inter-agency cooperation. A global network of radio telescopes, including the Robert C. Byrd Green Bank Telescope and eight of the ten antennas of the Very Long Baseline Array (VLBA), recorded the signal from Huygens during its descent to Titan on

January 14, 2005, providing critical data needed to measure winds in the moon's atmosphere and confirm the spacecraft's landing on Titan.

This quarter also saw the release of a high interest press release describing the extraordinary outburst and behavior of the magnetar SGR 1806-20. Though the enormous blast from SGR 1806-20 was first detected on December 27, 2004 by orbiting gamma-ray and X-ray telescopes, astronomers using the VLA produced a wealth of surprising and exciting science. This was the brightest outburst detected from an object beyond our Solar System; the gamma and X-ray bursts even disturbed the Earth's ionosphere and disrupted some radio communications. This release was issued jointly with the National Science Foundation (NSF) Office of Legislative and Public Affairs (OLPA). Working against deadline, OLPA and NRAO media specialists worked together to produce a release, graphics, and a broadcast-quality animation. This joint NRAO – NSF effort was highlighted as an example of effective cooperation between OLPA and a research organization at an NSF-sponsored workshop for University public information officers at the February American Association for the Advancement of Science (AAAS) meeting.

The Observatory distributed a press release announcing that former AUI President Riccardo Giacconi was being awarded the National Medal of Science, the nation's highest honor for American scientists. The National Medal of Science is awarded annually to individuals "deserving of special recognition for their outstanding contributions to knowledge." Giacconi was honored for his pioneering research in X-ray astronomy and for his visionary leadership of major astronomy facilities.

The Observatory also released the news that Eric Greisen will receive the American Astronomical Society's (AAS) prestigious George Van Biesbroeck Prize. This prize "honors a living individual for long-term extraordinary or unselfish service to astronomy, often beyond the requirements of his or her paid position." The AAS cited Greisen's quarter-century as "principal architect and tireless custodian" of the Astronomical Image Processing System (AIPS) as "an invaluable service to astronomy."

EPO Public Information Officer Dave Finley was an invited participant in a panel discussion on "Public Misperceptions of Science and Engineering" at the February American Association for the Advancement of Science meeting in Washington D.C.

Astronomical Community

At the January 2005 American Astronomical Society (AAS) meeting in San Diego, NRAO personnel staffed the Observatory's recently re-designed exhibit space and discussed the Observatory's mission, science, facilities, construction projects, and programs with the students, faculty, research scientists, media, corporate representatives, managers, and others who visited the exhibit hall. The NRAO distributed four press releases in San Diego that described new research being presented at the AAS meeting. NRAO scientific results were featured in two AAS press conferences, one on brown-dwarf results (Rachel Osten et al), and a second on the Green Bank Telescope's discovery of more than two dozen pulsars in the globular cluster Terzan 5 (Scott Ransom et al). NRAO Public Information

Officers Dave Finley and Andrea Gianopoulos—in her first week of employment at the Observatory–assisted the AAS Press Officer in staffing the press room throughout the meeting.

Figure 2. Rachel Osten (NRAO) discusses brown dwarf research at an AAS meeting press conference in San Diego. L.C. Quick (NC A&T State University), who participated in the NRAO Research Experiences for Undergraduates program last summer and collaborated with Osten, is seated at the right. H. Shipman (Univ of DE) is seated next to Ms. Quick. T. Bastian (NRAO) and S. Hawley (Univ of WA) were also collaborators in the research being discussed.

Education

The NRAO was notified on February 3 that its proposal to jointly operate the 2005 West Virginia Governor's School for Mathematics and Science (GSMS) with the National Youth Science Foundation had been selected and awarded $115,000. This program is funded by the West Virginia Experimental Program to Stimulate Competitive Research (EPSCoR). Sixty gifted eighth-grade students from West Virginia schools will be selected from more than 300 applicants to participate in this summer's GSMS, which will be held at Green Bank July 31 through August 13, 2005. This program seeks to instill in middle school students a strong appreciation for mathematics and the sciences before they make critical decisions that will guide their future academic and professional careers. The central theme for this GSMS will be radio astronomy research, and the students will be immersed in exciting activities at the Observatory, including observing with the 40-foot telescope and interacting with the Observatory's scientific staff.

Education and Public Outreach

In mid-February the Observatory submitted a proposal to a National Science Foundation – Office of Multi-disciplinary Studies grants program: MPS Internships for Public Science Education. The purpose of this proposal is to initiate collaborations with undergraduate and graduate students in museum studies, graphic arts, and engineering to develop a traveling mini-exhibit on radio astronomy, the NRAO, and the Green Bank Telescope.

Visitor Centers

Table 1 lists the visitation figures for the Green Bank Science Center and the VLA Visitors Center for this quarter, January – March 2005. Compared to the same months in 2004, visitation at the Green Bank Science Center increased by 6.2% (153 persons). Visitation at the VLA Visitor Center for these three months, however, decreased by 16.2% (726 persons).

Table 1. Green Bank Science Center and VLA Visitor Center visitation, January – March 2005.

Site	Jan 05	Feb 05	Mar 05	Total
Green Bank	652	856	1,101	2,609
VLA	1,056	904	1,803	3,763

Table 2 lists gross revenue for the Green Bank Science Center and the VLA Visitors Center for January – March 2005. Compared to the same months in 2004, gross revenue at the Green Bank Science Center decreased by 14.0% ($2,544); gross revenue at the VLA Visitor Center decreased by 3.4% ($855). Combined with the visitation figures above, these gross revenue numbers indicate a significant (15.2%) increase in the revenue per visitor at the VLA, but a similar (19.0%) decrease in the revenue per visitor at the Green Bank Science Center. In New Mexico, the period December 2004 – February 2005 saw the wettest weather on record for this period, and much of the recorded precipitation occurred on weekends, depressing visitation statewide.

Table 2. Green Bank Science Center and VLA Gift Shop gross revenue, January – March 2005

Site	Jan 05	Feb 05	Mar 05	Total
Green Bank	$4,099	$5,508	$ 6,028	$15,635
VLA	$6,292	$5,479	$12,305	$24,076

Community Relations

The NRAO staff provided a wide range of services to their communities this quarter. In January, Mark Adams gave an invited talk for the Blue Ridge Astronomy Club titled "The NRAO and the Future of Ground-based Radio Astronomy." With assistance from John Effland, Gerald Petencin, and Richard Bradley, EPO Public Information Officer Andrea Gianopoulos hosted a Tech Tour of the NRAO Technology Center on March 3 for 30 students sponsored by the Virginia Piedmont Technology Council. Rich Lacasse, mentored two Pocahontas High School students and received assistance from seven other Observatory engineering staff members. Richard Prestage taught an introductory computer science course at the Pocahontas County High School, and Tim Weadon provided computer training to the county's Family Resources Network staff. Sue Ann Heatherly continued her Mountain Radio Astronomy radio show in West Virginia, taping and broadcasting interviews with Observatory scientific and engineering staff, including Frank Ghigo, Toney Minter, Chelen Johnson, Bob Anderson, and John Hibbard. This quarter the Observatory sponsored the junior and senior earth and space science categories at the New Mexico State Science Fair, and sponsored prizes for the Magdalena Science Fair. Numerous NRAO staff assisted with the judging at the Magdalena Science Fair, including Doug Gerrard, James Sullivan, John McClendon, Charlie Barham, Bob Broilo, Guy Stanzione, Jim Ruff, Gustaaf van Moorsel, Lisa Foley, Pat Lewis, Richard Murillo, and Lonnie Guin.

Figure 3 Richard Murillo, Pat Lewis, John McClendon and Jim Ruff at the Magdalena, NM science fair.

Environment, Safety and Security

Environment, Safety, and Security (ES&S) Highlights

ES&S provided support at the Antenna Test Facility (ATF) for ALMA affected personnel to allow access to the prototype antennas and to ensure proper use of heavy equipment. ATF access procedures were finalized and controls established to assure employee safety. This quarter focused efforts to ensure safety in Socorro was appropriately addressed with the departure of a long-time Safety Officer. This included sessions for supervisors on their role in safety. ES&S compiled the annual emissions of the site diesel generators and submitted the results via the EPA New Mexico Air Quality Bureau Emission Inventory Report. In Green Bank, ES&S became involved in the MIT-LL-NRAO 43 meter project. In Charlottesville, ES&S provided Fire and Life Safety sessions on proper evacuation and response actions for emergencies. The Edgemont Road State Fire Marshal inspection was completed and all items identified necessary to obtain the certification for use and occupancy was achieved. Next quarter, ES&S will begin to provide service to the Joint ALMA Office to develop the ALMA Safety Program.

ALMA

ES&S provided training support at the Antenna Test Facility for ALMA affected personnel. The training provided included fall protection to allow access to the prototype antennas and also included manlift sessions to ensure personnel were appropriately trained in the use of heavy equipment. The access procedures were finalized and access controls established to assure employee safety. Negotiations were entered to provide support for the ALMA program in the development of the project and operational safety programs.

New Mexico

This quarter focused on the efforts necessary to ensure that the safety in Socorro was appropriately addressed with the departure of a long-time Safety Officer. Work efforts were re-prioritized to account for the reallocation of the safety resources.

ES&S continued support of the development and design specifications for the new gaseous fire suppression system to be installed in the EVLA Correlator Shielded Room. During this quarter ES&S provided the AOC and VLA management safety sessions to review the supervisors role in safety.

This quarter, ES&S compiled the annual emissions of the site diesel generators and submitted the 2004 year total on the EPA New Mexico Air Quality Bureau Emission Inventory Report. ES&S also completed and submitted the 2005 renewal application paper work for the Emergency Medical Services (EMS), first responders that constitute the NRAO/VLA Emergency Services group.

Environment, Safety and Security

The NRAO-wide safety footwear and safety eyewear programs were modified to provide additional coverage for employees and ensure compliance with OSHA regulations.

Green Bank

This quarter a Safety Officer was hired to fill the vacancy left from the retirement of the Socorro Safety Officer. Initial work efforts included a period of orientation followed by an emphasis on training and site inspections. ES&S efforts included a completion of the annual fire extinguisher site evaluation, and the inspection and maintenance of medical response first aid kits. Training efforts at Green Bank included the annual Bloodborne Pathogens training, the periodic Forklift (Powered Industrial Truck) training and a refresher of Hazard Communication training sessions.

ES&S addressed the fire safety issues of sprinkler head protection in the bunkhouse to reduce the risk of accidental release of the sprinkler system.

This quarter, ES&S became involved in the MIT-LL-NRAO 43 meter project. Specific safety areas being addressed include the facility's gaseous fire protection system, emergency exits, building security, fall protection, and painting. In addition, ES&S coordinated inspection of the elevators on-site to ensure safe operation.

Charlottesville

This quarter ES&S provided Fire and Life Safety sessions to orient employees with the proper evacuation and response actions for emergencies. ES&S met with the State Fire Marshal to review outstanding items in the Edgemont Road construction activities. The State Fire Marshal inspection was completed and all items identified necessary to obtain the certification for use and occupancy was achieved. This was necessary to allow the relocation from Old Ivy Commons to progress. Additionally, ES&S participated in the training programs to detail the operation and controls of the smoke detection and sprinkler systems. This reviewed the necessary communication with UVA for emergency response.

ES&S participated in the local Business Managers, meeting where the parameters of the NRAO-wide Vehicle Safety Program were defined.

Future Efforts

In the next quarter, ES&S will undergo a shift in focus. ES&S is planned to provide a year of service to the Joint ALMA Office to develop the ALMA Safety Program. The resources for the ES&S office will be shifted to cover this need and to address the needs of the remainder of the Observatory. Safety administrative responsibilities will be shifted to Dale Webb while ES&S program priorities will be defined by Jody Bolyard. Local support safety officers will remain in Socorro and Green Bank.

Environment, Safety and Security

The ES&S Division replaced the open position with support in Green Bank. The current staffing level of ES&S is as follows:

Location	Position	FTEs
Green Bank	ES&S Manager	1
Green Bank	Administrative, Safety Officer	1 ½
Socorro, VLA	Safety Officer	1
Tucson	Deputy Safety Officer	0
Charlottesville	Deputy Safety Officer	0
ALMA Project, VLA Site	Safety Officer	0
NRAO ES&S Total		3 ½

Telescope Usage

The NRAO telescopes were scheduled for research and maintenance during the first 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 with 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	1591.0	1056.05	1494.0
Scheduled Maintenance and Equipment Changes	249.0	221.00	198.0
Scheduled Tests and Calibration	304.0	372.95	468.0
Time Lost	150.0	50.18	193.0
Actual Observing	1441.0	1005.87	1301.0

GBT Observing Programs

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

No.	Observer(s)	Programs
BB202	Bower, G. (UC, Berkeley) Anderson, J. (Rice)	Trigonometric parallax of a radio star in the pleiades. 3.5 cm
BD103	Desmurs, J. (Obs Astronomico Nacio) Soria-Ruiz, R. (Obs Astronomico Nacio) Bujarrabal, V. (Obs Astronomico Nacio) Alcolea, J. (Obs Astronomico Nacio) Colomer, F. (Obs Astronomico Nacio)	High dynamic range map of SiO maser emission in IRC+10011.
BJ052	Jerkstrand, A. (Onsala Space Obs) Conway, J. (Onsala Space Obs) Minier, V. (CEA) Pestalozzi, M. (Onsala Space Obs) Booth, R. (Onsala Space Obs) Elitzur, M. (Kentucky)	Deep images of the circumstellar methanol disk in NGC7528-IRS1. 2 cm
BK121	Kouveliotou, C. (MSFC/NASA) Garrett, M. (JIVE) Gaensler, B. (CfA) Wijers, R. McLaughlin, M. (Manchester) Fender, R.P. (Amsterdam)	Multiepoch VLBA observations of SGR 1806-20. 21 cm
BU027	Ulvestad, J. Neff, S. (GSFC) Teng, S. (Maryland)	Monitoring young supernovae in Arp 299. 3.5, 11 cm
BU030	Ulvestad, J. Johnson, K. (Virginia) Neff, S. G. (GSFC)	A search for young supernovae in super star clusters. 6 cm
GB053	Bartel, N. (York) Bietenholz, M. (York)	The expansion, structure, and distance of SN 1979C. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT01A-005	Turner, B. Langston, G.	A high-resolution spectral survey of Tmc-1 at Q-Band.
GBT01A-020	Hollis, J. M. (NASA/GSFC) Jewell, P. Snyder, L. (Illinois) Lovas, F. (NIST)	A GBT Q-Band search strategy for interstellar glycine.
GBT02A-008	Roberts, M. Maddalena, R. Haynes, M. (Cornell) Hogg, D.	A study of the hydrogen reservoir surrounding galaxies. 21 cm
GBT02A-035	Yun, M. (Massachusetts) Carilli, C. Rupen, M. Wootten, H. A. Bertoldi, F. (Radioastron Institute, Bonn) Eales, S. (Cardiff) Ivison, R. (Astron Technology Centre)	Cosmic evolution of the most luminous submm galaxies. 1.3, 2 cm
GBT02A-069	Fisher, R.	Galaxy survey of HI emission. 21 cm
GBT02C-017	Bolatto, A. (UC, Berkeley) Balser, D. Wright, M. (UC, Berkeley)	Probing the physical state of high redshift galaxies (CO). 2 cm
GBT02C-033	Liszt, H. Gerin, M. (Ecole Normale Superieure) Lucas, R. (IRAM - Grenoble)	Search for C_4H absorption in diffuse clouds at 19 GHz. 1.3 cm
GBT02C-054	Braatz, J. Henkel, C. (MPIfR) Wilson, A. (Maryland) Greenhill, L. (CfA) Moran, J. (CfA)	Measuring nuclear disks in NGC 1386 and IC 2560 (H_2O). 1.3 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT03B-018	Shirley, Y. Wootten, H. A.	Probing hydrocarbon chemistry with C_4H and C_4D towards IRAS 16293-2422.
GBT03C-028	Walter, F. (MPIfA) Carilli, C. Lo, K. Y. Bertoldi, F. (Radioastron Institute, Bonn) Cox, P. (IAS/Instit. d'Astrophys. Spatiale) Fan, X. (Arizona State) Strauss, M. (Princeton) Menten, K. (MPIfR)	The molecular gas content in z>6 quasars: probing the end of cosmic reionization.
GBT03C-031	Jacoby, B. (Caltech) Anderson, S. (Caltech) Kulkarni, S. (Caltech) Kaplan, D. (MIT) Backer, D. (UC, Berkeley)	Timing the pulsars in M62, NGC 6544, and NGC 6624 and search for ultra-fast pulsars. 11, 21, 38 cm
GBT04A-001	Vanden Bout, P. Solomon, P. (SUNY, Stony Brook) Carilli, C.	Q-Band CO observations.
GBT04A-005	Barvainis, R. (NSF) Antonucci, R. (UCSB)	Search for water megamasers from type 2 quasars at z = 0.44 - 0.83. 2 cm
GBT04A-018	Robishaw, T. (UC, Berkeley) Heiles, C. (UC, Berkeley) Goldsmith, P. (Cornell)	CCS: The molecular magnetometer of choice. 3.5 cm
GBT04A-029	Ransom, S. Camilo, F. (Columbia Astrophysics Lab) Stairs, I. (British Columbia) Kaspi, V. (McGill) Kaplan, D. (MIT)	S-Band pulsar observations of Terzan 5 and Liller 1. 11 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04A-035	Stairs, I. (British Columbia) Faulkner, A. (NRAL) Kramer, M. (NRAL) Lyne, A. (NRAL) Manchester, D. (ATNF) Hobbs, G. (ATNF) Possenti, A. (Osservatorio di Cagliari) Lorimer, D. (Manchester) Kaplan, D. (MIT) Camilo, F. (Columbia Astrophysics Lab)	Scintillation velocities for two relativistic binary pulsars. 11, 21 cm
GBT04B-011	Rickett, B. (UCSD) McLaughlin, M. (Manchester) Coles, W. (UC, San Diego) Lyne, A. (NRAL) Stairs, I. (British Columbia) Camilo, F. (Columbia Astrophysics Lab) Freire, P. (Arecibo Observatory)	Scintillation studies of the J0737-3039 binary system. 6, 11 cm
GBT04B-014	Kondratko, P.(CfA) Greenhill, L. (CfA) Moran, J. (CfA) Braatz, J.	Anchoring the extragalactic distance scale. 1.3, 2 cm
GBT04B-026	Kramer, M. (NRAL) Stairs, I. (British Columbia) Camilo, F. (Columbia Astrophysics Lab) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Lyne, A. (NRAL) Manchester, D. (Australia Telescope) Possenti, A. (Osservatorio di Cagliari) D'Amico, N. (Osservatorio di Cagliari) Burgay, M. (Osservatorio di Bologna) Freire, P. (Arecibo Observatory) Joshi, B. (NCRA) Ferdman, R. (British Columbia)	Timing the first double pulsar system. 21, 38 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04B-028	Ransom, S. Kaspi, V. (McGill) Backer, D. (UC, Berkeley) Ramachandran, R. (UC, Berkeley) Demorest, P. (UC, Berkeley) Arons, J. (UC, Berkeley)	Multi-epoch multi-frequency scintillation velocity measurements of the double-pulsar binary J0737-3039. 21, 38 cm
GBT04B-029	Stairs, I. (British Columbia) Camilo, F. (Columbia Astrophysics Lab) Kramer, M. (NRAL) Faulkner, A. (NRAL) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Lyne, A. (NRAL) Hobbs, G. (ATNF) Manchester, D.R. N. (ATNF) Possenti, A. (Osservatorio di Cagliari) D'Amico, N. (Osservatorio di Cagliari) Burgay, M. (Osservatorio di Bologna) Ferdman, R. (British Columbia) Ramachandran, R. (UC, Berkeley) Backer, D. (UC, Berkeley) Demorest, P. (UC, Berkeley) Nice, D. (Princeton)	Timing new binary and millisecond pulsars from the Parkes multibeam survey. 21 cm
GBT04C-006	Vanden Bout, P. Solomon, P. (SUNY, Stony Brook) Maddalena, R.	Q-Band search for high redshift carbon monoxide line emission.
GBT04C-008	Pidopryhora, Y. (Ohio) Shields, J. (Ohio) Lockman, F. J.	Mapping the galactic halo HI: evidence of outflow from the galactic plane? 21 cm
GBT04C-011	Yun, M. (Massachusetts)	Hydrogen recombination lines in Starburst+AGN systems. 2 cm
GBT04C-012	Donovan, J. (Columbia) Camilo, F. (Columbia Astrophysics Lab)	Deep searches for young pulsars in “shell” supernova remnants. 38 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04C-013	Jacoby, B. (Caltech) Bailes, M. (Swinburne U. of Tech) Ord, S. (Swinburne U. of Tech) Kulkarni, S. (Caltech) Hotan, H. (Swinburne U. Tech) van Straten, W. (Astron)	Precision pulsar timing. 21, 38 cm
GBT04C-015	Cotton, W. Bridle, A. Fomalont, E. Laing, R. (ESO)	Continuum imaging of the very extended FRI radio sources 3C31, NGC315, NGC6251. 3.5, 6 cm
GBT04C-018	Bolatto, A. (UC, Berkeley) Darling, J. (Carnegie Institution)	A search for cosmological HI absorption systems toward radio selected flat-spectrum sources.
GBT04C-019	Kang, J. (Seoul National University) Koo, B-C. (Seoul National University) Salter, C. (Arecibo Observatory)	Faint HI 21-cm emission line wings at forbidden velocities. 21 cm
GBT04C-028	Chandler, C. Brogan, C. (JCMT) Shirley, Y. Indebetouw, R. (Wisconsin)	A search for CCS in massive protostellar candidates and infrared dark clouds. 1.3 cm
GBT04C-029	Dyer, K. Walter, F. (MPIfA) Rupen, M. Cornwell, T.	Crossing the critical junction: star formation between 1 and 10,000 GHz. 2, 6 cm
GBT04C-031	Kondratko, P. (CfA) Greenhill, L. (CfA) Moran, J. (CfA) Lovell, J. (ATNFc/o COSSA) Kuiper, T. (JPL) Jauncey, D. (ATNF)	Monitoring of five NGC4258-like water megamasers discovered with the GBT and the DSN. 1.3 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04C-036	Ramachandran, R. (UC, Berkeley) Deshpande, A. (Arecibo Observatory) Cordes, J. (NAIC and Cornell) Backer, D. (UC, Berkeley) Freire, P. (Arecibo Observatory) Vlemmings, W. (Cornell) Demorest, P. (UC Berkeley) Deneva, (Cornell)	Searching for young pulsars in the cygnus super bubble region. 11 cm
GBT04C-037	Shirley, Y. Wootten, H. A. Shepherd, D.	GBT & VLA ammonia thermometry towards low-mass star-forming Cores. 1.3 cm
GBT04C-039	Bower, G. (UC, Berkeley) Ramachandran, R. (UC, Berkeley) Muno, M. (UC, Los Angeles) Baganoff, F. (MIT)	Searching for radio pulsations from X-ray sources with radio counterparts in the galactic center. 3.5 cm
GBT04C-041	Braatz, J. Henkel, C. (MPIfR)	Monitoring extragalactic H_2O masers discovered with the GBT. 1.3 cm
GBT04C-049	Kovalev, Jr., Y. Tyulbashev, S. (Pushino Radio Astronomical Observatory, Lebedev)	GBT broad-band spectrometric measurements of large faraday rotations in AGN. 6, 11 cm
GBT04C-050	Lane, W. (NRL) Fisher, R. Kanekar, N. Darling, J. (Carnegie Institution)	Measurement of variable redshifted absorption. 21 cm
GBT04C-054	Carilli, C. Langston, G. Rocha, G. (Cambridge) Menten, K. (MPIfR) Reid, M. J. (CfA) Stocke, J. (Colorado)	A search for molecular absorption in the lensing galaxy toward the red gravitational lens J0134-0931. 1.3, 2 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT04C-055	Hewitt, J. (Northwestern) Yusef-Zadeh, F. (Northwestern) Braatz, J. Palmer, P. (Chicago)	A search for OH(4765 MHz) maser emission associated with supernova remnant masers using the GBT. 6 cm
GBT04C-056	Demorest, P. (UC, Berkeley) Backer, D. (UC, Berkeley) Ferdman, R. (British Columbia) Stairs, I. (British Columbia) Nice, D. (Princeton) Ramachandran, R. (UC, Berkeley)	Precision timing of binary and millisecond pulsars. 21, 38 cm
GBT05A-002	Fish, V.	A search for interstellar OD in massive star-forming regions. 21 cm
GBT05A-003	Campbell, B. (Smithsonian Institute) Carter, L. (Smithsonian Institution) Campbell, D. (Cornell)	Radar mapping of the Moon at 70-cm wavelength using Arecibo and the GBT. 70 cm
GBT05A-004	Kavars, D. (Minnesota) Dickey, J. (Minnesota) Skillman, E. (Minnesota)	OH observations of HI self-absorption clouds. 21 cm
GBT05A-005	Mason, B. Lockman, F. J.	Measuring the hydrogen column density towards Abell 478. 21 cm
GBT05A-007	Widicus, S. (Caltech) Blake, G. (Caltech)	A Ka- and Q-Band complex molecule survey of Orion and Sagittarius B2(N-LMH).
GBT05A-010	Robishaw, T. (UC, Berkeley) Heiles, C. (UC, Berkeley)	Constraining the magnetic field in the Taurus molecular cloud. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05A-011	Ransom, S. Camilo, F. (Columbia Astrophysics Lab) Stairs, I. (British Columbia) Kaspi, V. (McGill) Hessels, J. (McGill) Freire, P. (Arecibo Observatory)	Timing of the binary and millisecond pulsars in Terzan 5. 11, 38 cm
GBT05A-012	Morgan, L. (Kent) Urquhart, J. (Kent) Thompson, M. (Radio Astronomy Group)	Ammonia observations of bright rimmed clouds. 1.3 cm
GBT05A-015	Kondratko, P. (CfA) Greenhill, L. (CfA) Braatz, J. Moran, J. (CfA)	Search for extragalactic water maser emission with the GBT: Independent measurement of the Hubble Constant. 1.3 cm
GBT05A-016	Donovan, J. (Columbia) Camilo, F. (Columbia Astrophysics Lab)	Deep searches for young pulsars in "shell" supernova remnants. 38 cm
GBT05A-018	Hainline, (Caltech) Blain, A. (Caltech) Yun, M. (Massachusetts) Scoville, N. (Caltech)	Searching for cool molecular gas in high-z submillimeter-bright QSOs from CO(1-0) at GBT.
GBT05A-020	Shirley, Y. Li, Z. (Virginia)	The chemical and dynamical state of purportedly nascent pre-protostellar cores in Lynds 1521. 1.3 cm
GBT05A-021	Smits, D. (South Africa) De Witt, A. (South Africa)	Shock-excited OH (1720 MHz) masers in herbig-haro objects. 21 cm
GBT05A-031	Margot, J. (Cornell) Peale, S. (UC, Santa Barbara) Slade, M. (JPL)	The interior of mercury revealed by its spin dynamics. 3.5 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05A-032	Greve, T. (Caltech) Ivison, R. (Astronomy Technology Centre) Papadopoulos, P. (Institute for Astronomy, ETH Zurich, Switzerland) Smail, I. (Durham) Blain, A. (Caltech)	Probing the dense, starforming gas in high-redshift starburst galaxies. 1.3 cm
GBT05A-033	Stairs, I. (British Columbia) Camilo, F. (Columbia Astrophysics Lab) Kramer, M. (NRAL) Faulkner, A. (NRAL) McLaughlin, M. (Manchester) Lorimer, D. (Manchester) Lyne, A. (NRAL) Hobbs, G. (ATNF) Manchester, D. (ATNF) Possenti, A. (Osservatorio di Cagliari) D'Amico, N. (Osservatorio di Cagliari) Burgay, M. (Osservatorio di Bologna) Ferdman, R. (British Columbia) Ramachandran, R. (UC, Berkeley) Backer, D. (UC, Berkeley) Demorest, P. (UC, Berkeley) Nice, D. (Princeton)	Shapiro delay in the PSR J1802-2124 system. 21 cm
GBT05A-034	Hibbard, J. Corbin, (Arizona State) Vacca, W. (SOFIA-USRA)	Ultracompact blue dwarfs: Galaxy formation in the local Universe? 21 cm
GBT05A-038	Stinebring, D. (Oberlin College) Minter, A. Ransom, S. Hill, A. (Oberlin College)	Pulsar scintillation arc time variations. 21, 38 cm

GBT Observing Programs

No.	Observer(s)	Programs
GBT05A-041	Demorest, P. (UC, Berkeley) Backer, D. (UC, Berkeley) Ferdman, R. (British Columbia) Stairs, I. (British Columbia) Nice, D. (Princeton) Ramachandran, R. (UC, Berkeley)	Precision timing of binary and millisecond pulsars. 11, 21 cm
GBT05A-042	Baker, A. (Maryland) Mulchaey, J. (Carnegie Institution) Zabludoff, A. (Arizona) O'Neil, K.	HI observations of Isolated Ellipticals 21 cm
GBT05A-045	Roychowdhury, S. (Raman Research Institute) Mohan, R. (Raman Research Institute) Roshi, A. (Raman Research Institute)	A search for HI 21-cm line emission towards cooling flow clusters with 12CO line emission. 21 cm
GD017	Diamond, P. (MERLIN/VLBI) Lonsdale, C. (Haystack Observatory) Lonsdale, C. (Caltech IPAC) Smith, H. (UCSD)	Monitoring the evolution of the compact emission of Arp220. 21 cm
GD018	Darling, J. (Carnegie Institution of Washington) Diamond, P. (MERLIN/VLBI)	VLBI of the variable OH megmaser source IRAS02524+2046. 21 cm

GBT Observing Programs

No.	Observer(s)	Programs
GG057	Gurvits, L. (JIVE) Pogrebenko, S. (JIVE) Avruch, I. (JIVE) Bignall, H. (JIVE) Campbell, R. (JIVE) Garrett, M. (JIVE) Lebreton, J. van t Klooster, C. (ESA-ESTEC) Folkner, W. (JPL) Preston, R. (JPL) Romney, J. Bird, M. (U Bonn)	VLBI and Doppler tracking of the Huygens Titan Probe. 11 cm
GM059	Marcaide, J. M. (Valencia) Marti-Vidal, I. (Valencia) Guirado, J. C. (Valencia) Alberdi, A. (Instit de Astrofisica de An) Perez-Torres, M. (Instituto di Radioastro) Lara, L. (Granada) Ros, E. (MPIfR) Stockdale, C. (NRL) Weiler, K. W. (NRL) Sramek, R. A. Panagia, N. (Space Telescope Science Institute) Van Dyk, S.D. (Caltech)	ToO Observations of SN2004et at 1.3 and 3.6 cm. 3.5 cm

VLA Observing Programs

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

No.	Observer(s)	Programs
AA297	Araya, E. (NMIMT) Hofner, P. Goss, W.M. Kurtz, S. (Mexico/UNAM) Olmi, L. (Puerto Rico) Linz, H. (Puerto Rico)	VLA Search for H_2CO masers based on Arecibo and GBT surveys. 6 cm
AB1043	Blundell, K. (Oxford) Cruz, M.J. (Oxford) Peck, A. (CfA	Gas in the host galaxies of recently triggered powerful radio galaxies. 90 cm
AB1145	Brunthaler, A. (JIVE) Falcke, H. (ASTRON) Greenhill, L.J. (CfA) Henkel, C. (MPIR, Bonn) Reid, M. (CfA)	Search for H_20 maser in M31. 1.3 cm
AB1151	Bartel, N. (York) Bietenholz, M. (York) Rupen, M.	Spectrum of pulsar/black-hole nebula in SN 1986J. 0.7, 1.3, 2, 3.5, 6, 20, 90 cm
AB1154	Bains, I. (NSW) Richards, A.M. (Manchester) Gledhill, T. (Hertfordshire) Yates, J. (London)	Imaging the young PN IRAS 20406+2953. 1.3, 2, 3.6, 6 cm
AB1156	Blomme, R. (Belgium) Rauw, G. (Liege) DeBecker, M. (Liege) Runacres, M. (Belgium) VanLoo, S. (Belgium)	Monitoring the colliding-wind binary Cyg OB2 8A. 6 cm
AB1157	Butler, B. Gurwell, M. (CfA)	7 mm observations of Pluto/Charon. 0.7 cm
AB1160	Blake, C. (Oxford) Pimbblet, K. (Queensland) Drinkwater, M. (Queensland)	Radio continuum mapping of filaments in the local super cluster. 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AB1162	Boone, F. (MPIR, Bonn) Brouillet, N. (Bordeaux) Braine, J. (Bordeaux) Kording, E. (MPIR, Bonn) Henkel, C. (MPIR, Bonn) Jimenez-Garate, M.A. (MIT) Rupen, M.	Nature of the ultra luminous X-ray source M81 X9. 3.5 cm
AB1164	Bower, G.C. (Calif., Berkeley) Cheung, C.C. (MIT) Falcke, H. (ASTRON) Markoff, S. (MIT) Canizares, C. (MIT) Jimenez-Garate, M.A. (MIT)	Bridging the luminosity gap: Radio through X-ray observations of M81*. 20 cm
AB1169	Berger, E. (Caltech)	Follow-up observations of the radio active brown dwarf 2MASS J00361617+1821104. 6 cm
AB1171	Becker, R. (Calif., Davis)	Missing field in Galactic plane survey. 20 cm
AC740	Chandler, C. Low, F. (Arizona) Wilner, D. (CfA) Claussen, M.	Debris disk around HD 98800. 0.7, 3.6 cm
AC742	Clarke, T. (Virginia) Sarazin, C. (Virginia) Blanton, E. (Virginia)	Structure of the cores of Abell 2597 and Abell 4059. 6, 20, 90 cm
AC744	Carilli, C. Menten, K. (MPIR, Bonn) Rocha, G. (Cambridge) Reid, M. (CfA) Stocke, J. (Colorado) Langston, G.	Search for molecular absorption toward red lensed quasar J0134-0931. 2 cm

VLA Observing Programs

No.	Observer(s)	Programs
AC750	Clarke, T. (Virginia) Lane, W. (NRL) Sarazin, C. (Virginia) Kassim, N. (NRL)	FRIs in high and low density environments. 90, 400 cm
AC761	Chatterjee, S. (Cornell) Brisken, W. Goss, W.M. Benson, J. Arzoumanian, Z. (NASA) Lazio, T.J.W. (NRL) Cordes, J. (Cornell) Vlemmings, W.H.T. (Cornell) Thorsett, S. (Calif., Santa Cruz) Lyne, A. (Manchester) Kramer, M. (Manchester)	Pulsar parallaxes: A preliminary VLA survey. 20 cm
AC767	Condon, J. Yin, Q.	Calibrators for GBT offset pointing and VLA/VLBA/ALMA Phase Referencing. 3.5 cm
AC770	Choi, M. (KAO-TRAO) Hamaguchi, K. (NASA) Tatesatsu, K. (NAOJ)	Structure of X-ray emitting protostars in R CrA region. 3.6, 6 cm
AC772	Cimo, G. (MPIR, Bonn) Ellingsen, S. (Tasmania) Carter, S. (Tasmania) Jauncey, D. (ATNF)	Intrinsic rapid variability of structures in the compact core PKS 1144-359? 20 cm
AC773	Cohen, A. (NRL) Lane, W. (NRL) Kassim, N. (NRL) Lazio, T.J.W. (NRL)	Search for z> 5 radio galaxies: 1.4 GHz follow-up of 74 MHz selected ultra-steep spectrum sources. 20 cm
AC774	Carrillo, M. (UNAM) Kurtz, S. (UNAM) Finley, J. (Purdue) Brisken, W.	Proper motion of PSR 1800-21. 3.6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AC778	Chandler, C. Brogan, C. (IfA) McMullin, J.	Deep imaging of the proto-multiple system IRAS 16293-2422. 0.7 cm
AC781	Cannon, J. (MPIA) Skillman, E. (Minnesota) Walter, F. (MPIA)	Relation between HI kinematics and the escape of Ly photons from starburst galaxies. 20 cm
AC789	Castangia, P. (Cagliari) Tarchi, A. (Cagliari) Henkel, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Braatz, J. Moscadelli, L. (Cagliari)	H20 maser in the merging system NGC 520: disk or nuclear kilomaser? 1.3 cm
AD498	DeLaney, T. (Minnesota) Rudnick, L. (Minnesota) Sankrit, R. (Johns Hopkins) Blair, W. (Johns Hopkins) Petre, R. (NASA/GSFC) Harrus, I. (NASA/GSFC)	Probing the dynamics of Kepler's supernova remnant. 6, 20 cm
AD506	Darling, J. (Carnegie) Carilli, C.	Identification of high redshift ultra-steep spectrum radio galaxies. 20 cm
AD508	Duc, P.A. (Saclay) Koribalski, B. (ATNF) Bournaud, F. (Paris) Brinks, E. (Guanajuato) Braine, J. (Bordeaux) Walter, F. (MPIA) Boquien, M. (Saclay)	Search for dark matter in the huge intergalactic HI ring around NGC 5291. 20 cm
AF414	Frail, D. Soderberg, A. (Caltech) Kulkarni, S. (Caltech)	Continued monitoring of the bright GRB 030329. 3.6, 6, 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AG671	Gaensler, B. (CfA) Chatterjee, S. (Cornell) Camilo, F. (Columbia) Vander Swaluw, E. (FOM) Stappers, B. (Amsterdam)	Proper motion of young pulsars and their bow shocks. 20 cm
AG673	Gelfand, J. (CfA) Williams, B. (CfA) Sjouwerman, L. Lazio, T. (NRL) Gaensler, B. (CfA) Kong, A. (CfA) Trudolyubov, S. (UC, Riverside)	High resolution radio imaging of M31 supernova remnants. 6, 20 cm
AG675	Gurwell, M. (Caltech) Butler, B.	Surface and lower atmosphere of Titan. 0.7, 1.3 cm
AG676	Golden, A. (Ireland) Doyle, J. (Armagh) Antonova, T. (Armagh)	Confirming dynamic radio spectra from brown dwarf coronae? 3.6, 6 cm
AG679	Goddi, C. (Cagliari) Moscadelli, L. (Cagliari)	Multi-frequency continuum observations toward the high-mass YSO in AFGL 5142. 0.7, 1.3, 2, 3.6 cm
AG683	deGregorio-Monsalvo, I. (LAEFF) Gomez, J.-F. (LAEFF)	Accurate position measurements of water masers in Bok globules: new maser detection in CB65. 1.3 cm
AG684	deGregorio-Monsalvo, I. (LAEFF) Gomez, J.-F. (LAEFF)	Study of a proto-stellar binary in CB 54. 1.3 cm
AG685	Goedhart, S. (Hartebeesthoek) Voronkov, M.A. (ASC) Minier, V. (Saclay) vanderWalt, D. (Potchefstroom) Gaylard, M. (Hartebeesthoek)	G9.62+0.20E: The nature of the periodic methanol maser flares. 0.7, 2 cm.

VLA Observing Programs

No.	Observer(s)	Programs
AG687	Greenhill, L. (CfA) Beuther, H. (CfA) Humphreys, E. (Onsala) Patel, N. (CfA) Melnick, G. (CfA) Moran, J. (CfA)	Line ratios of cm and sub-mm H20 masers in Orion-KL-physical conditions in star formation outflows. 1.3 cm
AH810	Hoare, M. (Leeds) Lumsden, S. (Leeds) Oudmaijer, R. (Leeds) Busfield, A. (Leeds) Diamond, P. (Manchester) Garrington, S. (Manchester) Muxlow, T. (Manchester) Gunn, A. (Manchester) Spencer, R. (Manchester) Cotton, W.D. Churchwell, E. (Wisconsin) Kurtz, S. (UNAM) Shepherd, D. Chandler, C. Mundy, L. (Maryland) Gibb, A. (Maryland) Ridge, N. (FCRAO) Dougherty, S. (DRAO) Gledhill, T. (Hertfordshire) Zijlstra, A. (Manchester) Fender, R. (Amsterdam)	Coordinated radio and infrared survey for high-mass star formation. 6 cm
AH847	Humphreys, E. (Chalmers, Onsala) Reid, M. (CfA) Greenhill, L. (CfA) Moran, J. (CfA) Argon, A. (CfA)	Monitoring of water maser spectrum and jet continuum of NGC 4258. 1.3, 3.6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AH868	Hatchell, J. (Exeter) Thompson, M.A. (Hertfordshire) Wyrowski, F. (MPIR, Bonn) Pillai, T. (MPIR, Bonn) Gibb, A. (Maryland)	SCAMPS: with or without HII regions? 2, 6 cm
AH869	Hoare, M.G. (Leeds) Urquhart, J. (Leeds) Lumsden, S. (Leeds) Oudmaijer, R. (Leeds) Busfield, A. (Leeds)	Massive star formation in the galaxy; completion of the RMS Survey. 6 cm
AH872	Hyman, S. (Sweet Briar) Lazio, T.J.W. (NRL) Kassim, N.E. (NRL)	New transient GCRT J1745-3009 toward the GC. 20 cm
AI116	Ivison, R. (Royal Obs) Webb, T. (Leiden) Yee, H. (Toronto) Hoekstra, H. (Groningen/Kapteyn) Gladders, M. (Carnegie Obs.)	1.4 GHz imaging of the red sequence cluster survey: super-lenses or star-bursting clusters?
AI117	Ivison, R. (ROE) Dunlop, J. (ROE) Reike, G. (Arizona) Egami, E. (Arizona)	Deep imaging of the Lockman Hole. 20 cm
AJ313	Johnson, K. (Wisconsin) Plante, S. (Laval)	Super star cluster formation in the low metallicity starburst galaxy SBS0335-052. 0.7, 1.3, 2, 3.6, 6 cm
AK583	Kulkarni, S. (Caltech) Soderberg, A.M. (CfA) Cenko, S. (Caltech) Frail, D. Harrison, F.A. (Caltech) Fox, D. (Caltech) Gal-Yam, A. (Tel Aviv) Moon, D-S. (Caltech)	Cosmic explosions. 0.7, 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AK585	Karovska, M. (CfA) Matthews, L.	Long-term monitoring of maser line and radio continuum fluxes of Mira. 0.7, 1.3, 3.5, 20 cm
AK598	Kouveliotou, C. (NASA) Gaensler, B. (CfA) Wijers, R. (Amsaterdam) McLaughlin, M. (Manchester) Garrett, M. (JIVE) Finger, M. (USRA)	Search for radio emission associated with a giant flare from SGR 1806-20. 3.5, 6, 20 cm
AK599	Kulkarni, S. (Caltech) Soderberg, A. (Caltech) Cenko, S. (Caltech)	Resolving the connection between SGR 1806-20, LBV 1806-20 and a dense star cluster
AK601	Kouveliotou, C. (NASA) Gelfand, J. (CfA) Gaensler, B. (CfA) Wijers, R. (SUNY) Taylor, G. Eichler, D. (Ben Gurion) Fender, R. (Amsterdam) Garrett, M. (JIVE)	Comprehensive study of morphology and evolution of radio afterglow from SGR 1806-20. 1.3, 3.6, 6 cm
AK602	Krause, O. (MPIA) Rieke, G. (Arizona) Bieging, J. (Arizona)	Superluminal jet from the supernova remnant Cas A. 3.5, 6 cm
AL625	Lang, C. (Iowa) Figer, D. (STScI) Najarro, F. (CSIC)	High resolution radio observations of newly discovered luminous blue variable (LBV) stars: Morphology and ionization. 0.7, 1.3, 3.6 cm
AL629	Lang, C. (Iowa) Kaaret, P. (Columbia) Rupen, M.	Radio counterpart of the Ultra-Luminous X-ray (ULX) Source in M82: Coordinated X-ray and radio observations. 3.5, 6 cm
AL636	Lim, J. (ASIAA) Carilli, C. White, S. (Maryland)	Imaging the atmospheres of red supergiant stars. 0.7, 1.3, 2, 3.6, 6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AL640	Loinard, L. (UNAM) Rodrigurez, L.F. ((UNAM Rodriguez, M.I. (UNAM)	Further astrometry of the T Tau system. 2 cm
AL645	Liszt, H. Pety, J. (IRAM) Lucas, R. (IRAM	Using the NH3 thermometer in diffuse clouds. 1.3 cm
AL646	Liszt, H. Pety, J. (IRAM) Lucas, R. (IRAM)	HI absorption in directions studied in mm wave and optical absorption spectra. 20 cm
AL648	Lim, J. (ASIAA) Hirano, N. (ASIAA) Ohashi, N. (ASIAA) Yeh, C-C. (ASIAA) Takakuwa, S. (CfA)	Dust disks and ionized jets in binary/multiple low-mass proto-stellar systems. 0.7, 1.3 cm
AL649	Leon, S. (IAA) Sabater Montes, J. (IAA) Verdes-Montenegro, L. (IAA) Verley, S. (IAA) Lisenfeld, U. (IAA) Perez-Ramirez, D (JAEN Bergond, G. (Michigan) Lim, J. (ASIAA)	Census and morphology of the radio core of a well-defined sample of isolated galaxies. Multi-wavelength analysis and database of isolated galaxies: AMIGA project. 3.5, 20 cm
AM777	Murgia, M. (Bologna) Parma, P. (Bologna) deRuiter, H. (Bologna) Mack, K-H. (ASTRON) Fanti, R. (Bologna)	Spectral index imaging of fossil radio galaxies. 90 cm
AM793	Monnier, J.D. (Michigan) Greenhill, L.J. (CfA) Tuthill, P.G. (Sydney) Danchi, W. (NASA)	Continuum monitoring of colliding wind binary WR 112. 3.6 cm

VLA Observing Programs

No.	Observer(s)	Programs
AM825	Morrison, G. (IPAC) Dickinson, M. (NOAO) Owen, F. Bauer, F. (Cambridge) Koekemoer, A. (Mt. Stromlo) Mobasher, B. (STScI) Chary, R.-R. (Caltech) Frayer, D.T. (Caltech)	Deep imaging of the GOODS northern field. 20 cm
AM827	Maia, M. (Valong) Schmiit, H.R. (NRL)	Radio continuum imaging of a complete, optically selected Seyfert sample. 3.5 cm
AN124	Neff, S. (NASA) Owen, F. Eilek, J. (NMIMT) Morganti, R. (ASTRON)	High sensitivity imaging of the intermediate scale radio emission in Centaurus A. 90 cm
AO185	Orru, E. (Cagliari) Feretti, L. (Bologna) Giovannini, G. (Bologna) Govoni, F. (Bologna) Lane, W. (NRL) Kassim, N. (NRL) Murgia, M. (Bologna) Perley, R.	Low-frequency study of powerful giant radio galaxies. 90, 400 cm
AO190	Osten, R. Jayawardhana, R. (Toronto)	Exploring radio emission from young brown dwarfs in TW Hya. 3.6 cm
AP452	Perley, R. Condon, J.J. Cotton, W.D. Lane, W. (NRL) Cohen, A. (NRL) Kassim, N. (NRL) Lazio, T.J.W. (NRL) Erickson, W. (Maryland)	4 Meter All-sky Survey (4MASS). 400 cm

VLA Observing Programs

No.	Observer(s)	Programs
AP478	Pedlar, A. (Manchester) Muxlow, T. (Manchester) Beswick, R. (Manchester) Argo, M. (Manchester) Wills, K. (Sheffield)	Further epochs monitoring of radio supernovae and SNR in nearby starbursts. 2, 3.6, 6, 20 cm
AP482	Pihlstrom, Y. (Caltech) Sjouwerman, L.	Galactic center 1720 MHz. 18 cm
AP485	Pidopryhora, Y. (Ohio) Liszt, H. Lockman, F. Rupen, M.	Temperature and molecular content of Galactic Halo HI Clouds. 18, 20 cm
AR545	Rupen, M. Mioduszewski, A. Dhawan, V.	Monitoring of X-ray binaries etc. 0.7, 1.3, 2, 3.6, 6, 20 cm
AR554	Romani, R. (Stanford) Greenhill, L. (CfA) Michelson, P. (Stanford)	Search for a kpc-scale jet in the high-z blazar Q0906+6930. 3.6, 6, 20 cm
AR561	Roberts, D.A. (Northwestern) Yusef-Zadeh, F. (Northwestern)	Search for thermal emission from the young sellar cluster at the Galactic Center. 0.7 cm
AR562	Ribo, M. (Saclay) Mirabel, I.F. (Saclay) Casares, J. (IAC) Combi, J. (Jaen)	New microquasar with unprecedented massive outflows. 2, 3.5, 6, 20 cm
AS796	Soderberg, A. (Caltech) Frail, D. Kulkarni, S. (Caltech) Chevalier, R. (Virginia)	Supernova/Gamma-ray burst connection. 1.3, 3.5, 6, 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AS800	Sjouwerman, L. Messineo, M. (Leiden) Habing, H. (Leiden) Honma, M. (NAO, Japan) Imai, H. (NFRA)	43 GHz SiO masers and astrometry with VERA in the Galactic Center. 0.7 cm
AS801	Schinnerer, E. (MPIA) Carilli, C. Scoville, N. (Caltech) Bertoldi, F. (MPIR, Bonn) Blain, A. (Caltech) Bondi, M. (Bologna) Ciliegi, P. (Bologna) Impey, C. (Arizona) Koekemoer, A. (Mt. Stromlo) LeFevre, O. (Marseille Obs) Urry, C. (Yale) Vettolani, P. (Bologna)	COSMOS deep 1.4 GHz imaging survey. 20 cm
AS806	Schmitt, H. (Virginia) Anderson, J. (NMIMT) Cid-Fernandes, R. (UFSC) Heckman, T. (STScI) Gonzales-Delgado, R. (IAA, Andalucia) Storchi-Bergmann, T. (UFRGS)	Radio properties of a complete sample of low luminosity AGN. 3.5, 6 cm
AS811	Stocke, J. (Colorado) Reynolds, C. S. (Maryland) Lane, W. (NRL) Kassim, N.E. (NRL)	Low frequency imaging of 3C401: X-ray cavities at high-z. 90, 400 cm
AS824	Sollins, P.K. (CfA) Ho, P.T.P. (CfA) Zhang, Q. (CfA)	Structure of ionized gas inside a UCHII region. 0.7, 1.3, 3.6 cm
AS826	Spangler, S. (Iowa) Ingleby, L. (Iowa)	Measuring strength and structure of coronal magnetic field at heliocentric distances of 5-12R. 18, 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AS828	Simpson, C. (Wellesley) Schillemat, K. (Clarkson) Claussen, M. Shirley, Y.	Survey for water masers from pre-proto stellar cores. 1.3 cm
AS830	Su, Y-N. (ASIAA) Liu, S.-Y. (ASIAA) Lim, J. (ASIAA) Chen, H-R. (ASIAA) Chang, C-M. (ASIAA)	Free-free emission in the Onsala 1 region. 1.3, 3.5 cm
AS831	Shepherd, D. Testi, L. (Arcetri) DePree, C. (Agnes Scott College) Scoles, S. (Agnes Scott College)	Role of accretion and outflow collimation in massive star forming regions. 3.5 cm
AS837	Skinner, S. (Colorado) Audard, M. (Columbia) Briggs, K. (Paul Scherrer Institute) Gudel, M. (Paul Scherrer Institute)	Search for radio continuum emission from optically erupting T Tauri Star V1118 Ori.
AT299	Terashima, Y. (ISAS) Ho, L. (DTM/Carnegie) Ulvestad, J.	Physics of accretion flows in ultra-low-luminosity AGNs. 3.5 cm
AT305	Tafoya, D. (UNAM) Gomez, Y. (UNAM) Patel, N. (CfA) Torrelles, J. (Barcelona) Anglada, G. (IAA) Gomez, J-F. (LAEFF) deGregorio-Mnsalvo, I. (LAEFF) Miranda, L. (IAA)	Search for a magnetized disk in the young planetary nebula IRAS 17347-3139. 0.7 cm
AU105	Ulvestad, J. Barvainis, R. (NSF) Antonucci, R. (Calif., Santa Barbara)	Continuum spectrum of water maser AGN at z=0.66. 1.3, 2, 3.6, 6, 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
AV279	Valdettaro, R. (Arcetri) Palla, F. (Arcetri) Migenes, V. (Guanajuato) Brand, J. (Bologna)	Search for water masers in bright rimmed clouds. 1.3 cm
AW605	Walter, F. (MPIA) Brinks, E. (Hertfordshire) deBlok, E. (Cardiff) Thornley, M. (Bucknell) Kennicutt, R. (Arizona)	Stuff that matters: Physical characteristics of the ISM in nearby galaxies. 20 cm
AW641	Weiler, K. (NRL) Stockdale, C. (NRL) Sramek, R. VanDyk, S. (UCLA) Panagia, N. (STScI) Marcaide, J. (Valencia) Lewin, W. (MIT) Pooley, D. (MIT) Immler, S. (Massachusetts) Ryder, S. (AAO)	Observations of core collapse supernovae (Type II). 1.3, 2, 3.5, 6, 20, 90 cm
AW651	Webb, T. (Leiden) Ivison, R.J. (ROE) Yee, H. (Toronto) Hoekstra, H. (Toronto) Gladders, M. (Carnegie)	1.4 GHz imaging of the red sequence cluster survey: super-lenses or star-bursting clusters? 20 cm
AW653	Wong, M. (UC, Berkeley) dePater, I.(UC, Berkeley) Sault, R.J. (ATNF)	Comprehensive Jupiter ammonia mapping projects. 2, 3.6 cm
AW655	Willson, R.F. (Tufts)	Decimeter and meter-wavelength bursts from the Sun. 90, 400 cm

VLA Observing Programs

No.	Observer(s)	Programs
AX009	Xu, Y. (Shanghai) Reid, M. (CfA) Menten, K. (MPIR, Bonn) Zheng, X. (Nanjing) Moscadelli, L. (Cagliari)	Parallaxes and proper motions of massive star forming regions: Step 2. 2 cm
AZ152	Zapata, L. (CfA) Ho, P.T.P. (CfA) Rodriguez, L.F. (UNAM)	Search for an embedded radio cluster in NGC 63341. 1.3 cm
AZ154	Zapata, L. (CfA) Rodriguez, L.F. (UNAM) Kurtz, S. (UNAM) O'Dell, C. (Vanderbilt) Ho, P.T.P. (CfA)	Nature of the new cluster of 1.3 cm continuum sources in OMC1 South. 0.7, 1.3 cm
AZ155	Zijlstra, A. (Manchester) Hajduk, M. (UMIST Kerber, F. (ESO) vanHoof, P. (Queens) Pollacco, D. (Queens) Evans, A. (Keele) Eyres, S. (Lancashire) Kimewenger, S. (Innsbruck)	Radio emergence of Sakurai's object. 3.5, 6 cm
BD101	Dougherty, S. (DRAO) Beasley, A.J. (JAO) Pittard, J. (Leeds) Claussen, M. Bolingbroke, N. (NRC) Zauderer, A. (Maryland)	Observing wind-collision and orbital motion in WR 140.
BD103	Desmurs, J-F. (OAN) Soria-Ruiz, R. (OAN) Bujarrabal, V. (OAN) Alcolea, J. (OAN) Colomer, F. (OAN)	High dynamic range map of SiO maser emission in IRC+10011. 0.7 cm
BK113	Kemball, A.J. (Illinois) Diamond, P. (Manchester)	New constraints on the near circumstellar environment of late type evolved stars. 20 cm

VLA Observing Programs

No.	Observer(s)	Programs
BR102	Ratner, M. (CfA) Bartel, N. (York) Bietenholz, M. (York) Lebach, D. (CfA) Lederman, J. (York) Lestrade, J.-F. (Meudon) Ransom, R. (York) Shapiro, I.I. (CfA)	Astrometry of HR 8703 in 2005. 2 cm
BU030	Ulvestad, J. Johnson, K. (Virginia) Neff, S. (NASA)	Search for young supernovae in super star clusters. 6 cm
GB053	Bartel, N. (York) Bietenholz, M. F. (York)	Expansion, structure, and distance of SN 1979C. 6, 18 cm
GD017	Diamond, P. (Manchester) Lonsdale, C.J. (Haystack) Lonsdale, C.J. (Caltech) Smith, H.E. (Caltech)	Monitoring evolution of compact emission of Arp 200. 6, 20 cm
GD018	Darling, J. (Carnegie) Diamond, P. (Manchester)	VLBI of the variable OH megamaser source IRAS0254+2046. 20 cm
GM059	Marcaide, J.M. (Valencia) Marti-Vidal, I. (Valencia) Guirado, J. (Valencia) Alberdi, A. (IAA) Perez-Torres, M.A. (IAA) Lara, L. (Granada) Ros, E. (MPIR, Bonn) Stockdale, C. (Marquette) Weiler, K. (NRL) Sramek, R. Panagia, N. (STScI) VanDyk, S. (Caltech)	Structure of SN 2004et. 1.3, 3.6 cm.

VLBA Observing Programs

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

No.	Observer(s)	Programs
BB192	Boboltz, D. (USNO) Driebe, T. (MPIR, Bonn) Ohnaka, K. (MPIR, Bonn) Wittkowski, M. (ESO)	Return to S Ori with VLBA and VLT1. 0.7 cm
BB199	vanBemmel, I. (STScI) Birkinshaw, M. (Bristol) Chiaberge, M. (IRA) Dullemond, K. (MPA) Macchetto, D. (STScI) Schmitt, H.	Core physics of powerful radio-loud active galaxies. 2, 6 cm
BB201	Boyce, E. Hewitt, J. (MIT) Myers, S.	Observations of gravitational lens central images. 6 cm
BB202	Bower, G.C. (Calif., Berkeley) Anderson, J. (Rice)	Trigonometric parallax of a star in the Pleiades cluster. 6 cm
BC120	Chatterjee, S. (Cornell) Backer, D. (UC, Berkeley) Benson, J. Brisken, W. Cordes, J. (Cornell) Ellis, R. (UC, Santa Cruz) Fomalont, E. Golden, A. (Ireland) Goss, W.M. Kramer, M. (Manchester) Lazio, T. (NRL) Lyne, A. (Manchester) McKinnon, M. Thorsett, S. (UC, Santa Cruz) Wong, D. (Cornell)	Pulsar astrometry with the VLBA. 20 cm
BC139	Claussen, M.	Tests of water maser phase referencing for

VLBA Observing Programs

No.	Observer(s)	Programs
	Beasley, A.J. (JAO) Goss, W.M. Moellenbrock, G.	astrometry of galactic water masers
BC146	Colomer, F. (OAN, Spain) Alcolea, J. (OAN, Spain) Bujarrabal, V. (OAN, Spain) Desmurs, J. (OAN, Spain) Soria-Ruiz, R. (OAN, Spain)	Relative spatial distribution of SiO masers in AGB Stars. 0.7 cm
BC147	Cotton, W.D. Danchi, W. (NASA/GSFC) Lacasse, M. (CfA) Ragland, S. (CfA) Schloerb, F. (UC, Berkeley) Townes, C. (UC, Berkeley) Traub, W. (CfA)	VLBA/IOTA observations of Miras with photospheric asymmetrics. 0.7 cm
BC150	Cheung, C.C. (MIT) Lee, N. (Brandeis) Wardle, J. (Brandeis)	Radio spectra and structure of the highest redshift quasar jets. 90 cm
BD101	Dougherty, S. (DRAO) Beasley, A. (JAO) Pittard, J. (Leeds) Claussen, M. Bolingbroke, N. (NRC) Zauderer, A. (Agnes Scott College)	Observing wind-collision and orbital motion in WR140. 0.7, 1.3, 2, 3.6 cm
BD103	Desmurs, J.-F. (OAN) Alcolea, J. (OAN) Colomer, F. (OAN) Soria-Ruiz, R. (OAN) Bujarrabal, V. (OAN)	High dynamic range map of SiO maser emission in IRC+10011. 0.7 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BD107	Dhawan, V. Mioduszewski, A. Rupen, M.	VLBA Astrometry of X-ray binaries. 2, 4 cm
BE026	Engels, D. (Sternwarte) Brand, J. (IRA-CNR) Perez-Torres, M-A. (IRA-CNR)	Search for bipolar outflows in young proto-planetary nebulae. 1 cm
BG152	Gabuzda, D. (Cork) Rastorgueva, E. (Moscow/SSAI) Smith, P. (Arizona)	Simultaneous radio and optical polarimetry of AGN jets. 0.7, 1, 2 cm
BG153	Goddi, C. (Cagliari) Brand, J. (IRA-CNR, Bologna) Moscadelli, L. (Cagliari) Tarchi, A. (IRA-CNR, Cagliari)	H20 maser kinematics close to high-mass YSOs. 1 cm
BG154	Greenhill, L. (CfA) Michelson, P. (Stanford) Romani, R. (Stanford)	Jet proper motion and millimeter spectral index in the High Z blazar Q0906-6930. 2 cm
BH113	Hong, S.Y. (ShAO) Jiang, D. (ShAO) Wang, W.H. (ShAO) Zhao, J.-H. (CfA)	Millimeter VLBA obs. of core structure on a sub-arc sec scale in AGN 1156+295 at z=0.729. 0.7, 2 cm
BH118	Hough, D. (Trinity) Aars, C. (Trinity) Porcas, R. (MPIR, Bonn) Taylor, G. Zensus, J.A. (MPIR,Bonn)	Multi-frequency polarization imaging of five Jodrell Bank lobe-dominated quasars. 2, 4, 6 cm
BH126	Harris, D. (SAO) Cheung, C. (Brandeis) Junor, W. (LANL)	Ongoing outburst of knot 'HST-1' in the M80 jet. 90 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BH127	Hough, D. (Trinity)	Innermost jet structure in the nuclei of the lobe-dominated quasars 3C207 and 3C245. 1, 2, 4 cm
BI030	Imai, H. (Kagoshima) Diamond, P. (Manchester)	Evolution on a water fountain in W43A. 1 cm
BJ036	Jorstad, S. (Boston) Marscher, A. (Boston) Yurchenko, A. (St. Petersburg)	BL Lac objects with high proper motion. 0.4, 0.7, 1, 2 cm
BJ048	Johnston, K. (USNO) Fey, A. (USNO) Ma, C. (NASA/GSFC) Gordon, D. (NASA/GSFC) Boboltz, D. (USNO) Kingham, K. (USNO) Vandenberg, N. (Interferometrics) Himwich, E. (Interferometrics) MacMillan, D. (Interferometrics) Petrov, L. (NASA/GSFC) Fomalont, E. Walker, R.C.	Geodesy/astrometry observations for 2000. 0.4, 13 cm
BJ052	Jerkstrand, A. (Onsala) Conway, J. (Onsala) Minier, V. (Saclay) Pestalozzi, M. (Onsala) Booth, R. (Onsala) Elitzur, M. (Kentucky)	Deep images of circumstellar methanol disk in NGC7528-IRS1. 2 cm
BJ056	Jonker, P. (CfA) Chatterjee, S. Fender, R. (Southampton) Gaensler, B. (CfA) McLaughlin, M. (Manchester) Wijers, R. (Amsterdam)	Milliarc-second scale jets in black hole X-ray transients. 4, 13 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BK107	Krichbaum, T. (MPIR, Bonn) Sohn, B. (MPIR, Bonn) Agudo, I. (IAA, Andalucia) Witzel, A. (MPIR, Bonn) Zensus, J. (MPIR, Bonn) Ungerechts, H. (Massachusetts) Terasranta, H. (Helsinki)	Precession of the jet nozzle of 1633+382 after a major millimeter flare? 1.3 cm
BK113	Kemball, A. (Illinois) Diamond, P. Manchester)	New constraints on the near-circumstellar environment of late-type evolved stars. 20 cm
BK121	Kouvelioutou, C. (NASA) Fender, R. (Southampton) Gaensler, B. (CfA) Garrett, M. (JIVE) McLaughlin, M. (Manchester)	Multi-epoch VLBA obs. of SGR 1806-20 following a giant X-ray flare. 20 cm
BK126	Kouvelioutou, C. (NASA) Fender, R. (Southampton) Gaensler, B. (CfA) Garrett, M. ((JIVE) Granot, J. (Stanford) Taylor, G.	Searching for compact structure in the flaring magnetar SGR 186-20. 4 cm
BL104	Lobanov, A. (MPIR, Bonn) Roland, J. (IAP, Paris) Ros, E. (MPIR, Bonn) Zensus, J. (MPIR, Bonn)	Cross-band monitoring of a flare in the VLBI core of 3C345. 0.7, 1, 2 cm
BL116	Lara, L. (Granada) Alberdi, A. (IAA, Granada) Guirado, J. (Valencia) Marcaide, J. (Valencia) Perez-Torres, M.A. (Bologna) Ros, E. (MPIR, Bonn)	Kinematics and rotation measure in the inner jet of 3C395. 0.7, 1, 2 cm

VLBA Observing Programs

No.	Observer(s)	Programs
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. (MPIR, Bonn)	MOJAVE Program. 2 cm
BL124	Loinard, L. (Mexico/UNAM) Mioduszewski, A. Rodriguez, L. (Mexico/UNAM) Rodriguez, M. (Mexico/UNAM) Torres, R. (Mexico/UNAM)	Parallax and proper motions of young stellar sources in Taurus. 0.4 cm
BM211	Marscher, A. (Boston) Aller, M. (Michigan) Gomez, J. (IAA, Granada) Jorstad, S. (Boston) McHardy, I. (Southampton)	Multi-frequency monitoring of the jets of selected blazars and radio galaxies. 1, 0.7 cm
BM215	Middelberg, E. (ATNF) Bach, U. (MPIR, Bonn) Krichbaum, T. (MPIR, Bonn) Roy, A. (MPIR, Bonn)	Fate of polarized emission in NGC 4261, Hydra A and Cygnus A. 0.7 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BM244	Ma, C. (NASA) Gordon, D. (NASA) Johnston, K. (USNO) Fey, A. (USNO) Vandenberg, N. (NASA) Gipson, J. (NASA) Boboltz, D. (USNO) Kingham, K. (USNO) MacMillan, D. (NASA) Petrov, L. (NASA) Fomalont, E. Walker, R.C.	VLBA Geodesy/Astometry Observations for 2005. 3.6 cm
BO019	Ojha, R. (ATNF) Fey, A. (USNO) Jauncey, D. (ATNF) Johnston, K. (USNO) Lovell, J. (ATNF)	VLBA Snap shot imaging of scintillating and non-scintillating sources. 4 cm
BP120	Piner, B. (Whittier) Edwards, P.G. (ISAS) Jones, D. (JPL)	Kinematics of the 26 c components in the blazar 0827+243. 2 cm
BR099	Ros, E. (MPIR, Bonn) Aller, H.D. (Michigan) Aller, M. (Michigan) Kadler, M. (MPIR, Bonn) Kerp, J. (MPIR, Bonn) Kovalev, Y. Marscher, A. (Boston) Weaver, K. (NASA)	NGC 1052, the key to explore the disk jet connection in AGN. 0.7, 1 cm
BR100	Reid, M. (CfA) Greenhill, L. (CfA) Menten, K. (MPIR, Bonn) Moscadelli, L. (Cagliari) Xu, Y. (Nanjing) Zheng, X.W. (Nanjing)	Spiral structure and kinematics of the Milky Way. 2 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BR102	Ratner, M. (CfA) Bartel, N. (York) Bietenholz, M. (York) Lebach, D.E. (CfA) Lederman, J. (York) Lestrade, J.-F. (Meudon) Ransom, R.R. (York) Shapiro, I.I. (CfA)	Astrometric monitoring of HR 8703 in 2005 for GPB mission. 2, 3.6, 6 cm
BS144	Iguchi, S. (NAO, Japan) Murata, Y. (JAXA/ISAS) Takaba, H. (Gifu) Taniguchi, Y. (Tohoku) Wakamatsu, K. (Gifu)	Astrometric monitoring of the radio galaxy 3C 66B. 0.4, 13 cm
BT070	Taylor, G. Peck, A. (CfA) Pollack, L. (UCB) Zavala, B.	Investigating the binary black hole system in 0402+379. 0.7, 2, 6 cm
BT075	Tarchi, A. (Cagliari) Brunthaler, A. (JIVE) Chiaberge, M. (Bologna) Henkel, C. (MPIR, Bonn) Menten, K. (MPIR, Bonn) Moscadelli, L. (Cagliari)	3C404: is the first water megamaser in an FRII associated with an accretion disk or is due to a jet interaction? 1 cm
BT079	van der Tak, F. (MPIR, Bonn) Hachisuka, K. (MPIR, Bonn) Menten, K. (MPIR, Bonn)	Proper motions of H_2O. 1 cm
BT081	Taylor, G. Giroletti, M. (CNR) Gugliucci, N. (Lycoming) Peck, A. (SMA)	Faraday rotation measure observations of two compact symmetric objects. 4, 6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
BT083	Taylor, G. Fabian, A. (IoA) Sanders, J. (IoA)	An investigation of the nucleus of PKS 1246-410 in Centaurus. 6 cm
BU027	Ulvestad, J. Neff, S. (NASA) Teng, S. (Maryland)	Monitoring young supernovae in Arp 299. 4, 13 cm
BU030	Ulvestad, J. Johnson, K. (Virginia) Neff, S. (NASA)	Search for young supernovae in super star clusters. 6 cm
BV053	Vlemmings, W. (Cornell) Chatterjee, S. (Cornell) Diamond, P. (Manchester) van Langevelde, H. (JIVE)	Parallax and proper motions of late-type stars OH maser VLBA astrometry with in-beam calibrators. 20 cm
BV055	Vlemmings, W. (Cornell) Diamond, P. (Manchester) Langevelde, H. (JIVE)	Monitoring the magnetic field on the water masers of U Ori. 1 cm
BV057	Vigotti, M. (CNR) Benn, C. (La Palma) Fanti, R. (Bologna) Fanti, C. (Bologna) Mack, K-H. (CNR)	First pc scale imaging of a BLA quasar at radio wavelengths. 4, 6, 20 cm
BW069	Wiik, K. (Tuorla) Raiteri, C. (Torino) Savolainen, T. (Tuorla) Takalo, L. (Tuorla) Villata, M. (Torino)	Multi-wavelength monitoring of a highly active blazar: BL Lac object AO 0235+16 during an outburst. 0.7, 2, 4, 6, 13 cm
BY019	Yuan, W. (IoA) Fabian, A. (IoA) Taylor, G.	Probing the nature of the soft X-ray spectral flattening in two high-redshift quasars

VLBA Observing Programs

No.	Observer(s)	Programs
GB053	Bartel, N. (York) Bietenholz, M. (York)	Expansion, structure and distance of SN 1979C. 6 cm
GD017	Diamond, P. (Manchester) Lonsdale, C. (Haystack) Lonsdale, C. (Caltech) Smith, H. (Caltech)	Monitoring evolution of compact emission of Arp 220. 18 cm
GG057	Gurvits, L. (JIVE) Pogrebenko, S. (JIVE) Avruch, I. (JIVE) Bignall, H. (JIVE) Campbell, R. (JIVE) Garrett, M. (JIVE) Lebreton, J. (ESA) vantKlooster, C. (ESA-ESTEC) Folkner, W. (JPL) Preston, R. (JPL) Romney, J. Bird, M. (Bonn)	VLBI and Doppler tracking of the Huygens Titan Probe. 3.6, 13 cm
GI001	Imai, H. (Kagoshima) Diamond, P. (Manchester)	Kinematics of expanding of circumstellar envelope of W43A. 18 cm
GM059	Marcaide, J. (Valencia) Marti-Vidal, I. (Valencia) Guirado, J. (Valencia) Alberdi, A. (IAA) Perez-Torres, M. (IAA) Lara, L. (Granada) Ros, E. (MPIR, Bonn) Stockdale, C. (Marquette) Weiler, K. (NRL) Sramek, R. Panagia, N. (STScI) VanDyk, S. (Caltech)	Structure of SN 2004et. 1.3, 3.6 cm

VLBA Observing Programs

No.	Observer(s)	Programs
GP042	Pedlar, A. (Manchester) Muxlow, T. (Manchester) Beswick, R. (Manchester) Diamond, P. (Manchester) Argo, M. (Manchester)	Observations of supernova remnants in M82. 18 cm

Personnel

NEW HIRES

Bishop, Marsha	Observatory Librarian	02/01/2005
Gianopoulos, Andrea	Public Information Officer	01/07/2005
McLeod, Morgan	Software Engineer II	03/01/2005
Metzner, Paula	Electronics Engineer I	03/21/2005
Russell, Adrian	Project Manager	01/07/2005
Saez, Alejandro	Electronics Engineer III	01/05/2005
Samples, Johnny	Safety Officer	02/01/2005

PROMOTIONS

Emerson, Nicholas	Mechanical Engineer II	01/01/2005
Holmstedt, Christian	Electronics Engineer II	01/01/2005
Patterson, James	Systems Administrator II	02/21/2005
Muehlberg, James	Electronics Engineer II	03/01/2005

TERMINATIONS

Dugan, Jennifer	Mechanical Engineer III	02/24/2005
Gasho, Victor	Division Head	02/11/2005
Rafal, Marc	Deputy Project Manager	03/01/2005
Reiland, George	Electronics Engineer I	03/01/2005
Shapiro, Lee	Head of EPO	02/28/2005

OTHER

Clark, Barry	Emeritus Scientist	01/01/2005

Publications

The following preprints were received in the NRAO Charlottesville Library during this reporting period and were authored by NRAO staff or based on observations on an NRAO telescope.

BERGER, E.; RUTLEDGE, R.E.; REID, I.N.; BILDSTEN, L.; GIZIS, J.E.; LIEBERT, J.; MARTIN, E.; BASRI, G.; JAYAWARDHANA, R.; BRANDEKER, A.; FLEMING, T.A.; JOHNS-KRULL, C.M.; GIAMPAPA, M.S.; HAWLEY, S.L.; SCHMITT, J.H.M.M. The Magnetic Properties of an L Dwarf Derived from Simultaneous Radio, X-ray, and H-alpha Observations.

BOBOLTZ, D.A.; DIAMOND, P.J. Axial Symmetry and Rotation in the SiO Maser Shell of IK Tauri.

CANNON, J. M.; WALTER, F.; SKILLMAN, E.D.; VAN ZEE, L. The Nature Of Radio Continuum Emission At Very Low Metallicity: Very Large Array Observations of I Zw 18.

CHEUNG, C.C.; WARDLE, J.F.C.; CHEN, T. Discovery of Optical Emission in the Hotspots of Three 3CR Quasars: High-Energy Particle Acceleration in Powerful Radio Hotspots.

CLARKE, T.E.; SARAZIN, C.L.; BLANTON, E.L.; NEUMANN, D.M.; KASSIM, N.E. Low Frequency Radio Observations of X-Ray Ghost Bubbles in Abell 2597: A History of Radio Activity in the Core.

DOUGHERTY, S.M.; BEASLEY, A.J.; CLAUSSEN, M.J.; ZAUDERER, B.A.; BOLINGBROKE, N.J. High Resolution Radio Observations Of The Colliding-Wind Binary WR 140.

FISH, V.L.; REID, M.J.; MENTEN, K.M. Magnetic Field Clumping in Massive Star-Forming Regions as Determined from Excited-State OH Absorption and Maser Emission.

FISHER, J.R.; ZHANG, Q.; ZHENG, Y.; WILSON,S.G.; BRADLEY, R.F. Mitigation of Pulsed Interference to Redshifted HI and OH Observations between 960 and 1215 MHz(2)

FURUYA, R.S.; CESARONI,R.; TAKAHASHI, S.; MOMOSE, M.; TESTI, L.; SHINNAGA, H.; CODELLA, C. Relative Evolutionary Time Scale of Hot Molecular Cores with Respect to Ultra Compact HII Regions.

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 HOST, 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.

IONO, D.; YUN, M.S.; HO, P.T.P. Atomic and Molecular Gas in Colliding Galaxy Systems. I. The Data.

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

KOGAN, L A Minimum Gradient Algorithm for Phased Array Null Formation.

LEDLOW, M.J.; OWEN, F.N.; MILLER, N.A. The Cluster of Galaxies Surrounding Cygnus A II: New Velocities and a Dynamical Model.

LIPSCY, S.J.; JURA, M.; REID, M.J. Radio Photosphere and Mass-Loss Envelope of VY CMa.

Publications

LOCKMAN, F.J.; CONDON, J.J. The Spitzer Space Telescope First-Look Survey: Neutral Hydrogen Emission.

LOINARD, L.; MIODUSZEWSKI, A.J.; RODRIGUEZ, L.F.; GONZALEZ, R.A.; RODRIGUEZ, M.I.; TORRES, R.M. Multiepoch VLBA Observations of T Tauri South.

MATTHEWS, L.D.; GAO, Y.; USON, J.M.; COMBES, F. Detections of CO in Late-Type, Low Surface Brightness Spiral Galaxies.

MILLER, N.A.; MUSHOTZKY, R.; NEFF, S. G. Radio Emission Associated with the ULX in Holmberg II.

MODJAZ, M.; MORAN, J.M.; KONDRATKO, P.T.; GREENHILL, L.J. Probing the Magnetic Field at Sub-Parsec Radii in the Accretion Disk of NGC 4258.

MOMJIAN, E.; CARILLI, C.L.; PETRIC, A.O. Sensitive VLBI Observations of the z = 4.7 QSO BRI 1202-0725.

RANSOM, S.M.; HESSELS, J.W.T.; STAIRS, I.H.; FREIRE, P.C.C.; CAMILO, F.; KASPI, V.M.; KAPLAN, D.L. Twenty-One Millisecond Pulsars in Terzan 5 Using the Green Bank Telescope.

RODRIGUEZ, L.F.; LOINARD, L.; D'ALESSIO, P.; WILNER, D.J.; HO, P.T.P. IRAS 16293-2422B: A Compact, Possibly Isolated Protoplanetary Disk in a Class 0 Object.

ROSHI, D.A.; BALSER, D.S.; BANIA, T.M.; GOSS, W.M.; DE PREE, C.G. An 8.5 GHz Arecibo Survey of Carbon Recombination Lines Toward Ultra-Compact H II Regions: Physical Properties of Dense Molecular Material.

ROSHI, D.A.; GOSS, W.M.; ANANTHARAMAIAH, K.R.; JEYAKUMAR, S. Multi-Wavelength Carbon Recombination Line Observations With the VLA Toward an Uch II Region in W48: Physical Properties and Kinematics of Neutral Material.

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

YOUNG, A.; RUDNICK, L.; KATZ, D.; DELANEY, T.; KASSIM, N.E.; MAKISHIMA, K. Canonical Particle Acceleration in FRI Radio Galaxies.

YUSEF-ZADEH, F.; BIRETTA, J.; WARDLE, M. Proper Motion of the Irradiated Jet HH 399 in the Trifid Nebula.

ZHANG, Q.; ZHENG, Y.; WILSON, S.G.; FISHER, J.R.; BRADLEY, R. Excision of Distance Measuring Equipment Interference from Radio Astronomy Signals.

Budget

The table below represents NRAO Operations (without EVLA) expenses and commitments for Fiscal Year 2005 through the end of the second quarter as reported at Work Breakdown Structure (WBS) Level 1.

Available funds for NRAO Operations (without EVLA) total $33,150,403. This amount includes $34,957,500 in new NSF Funds (less $5,340k for EVLA Phase 1 construction), $1,861,325 in prior year commitments and $1,671,578 in prior year carryover.

NRAO Operations Expenses and Commitments FY 2005 Year to Date (October 1, 2004 to March 31, 2005)

Work Breakdown Structure Element Level 1	Salaries & Benefits	Materials & Services	Travel	Revenue or Cost Recovery	Total
Observatory Management	$1,537,211	$4,879,265	$162,416	($93,502)	$6,485,390
Education and Public Outreach	$196,589	$93,073	$19,921	($60,019)	$249,564
Central Development Lab	$635,760	$24,899	$5,054	$0	$665,713
Green Bank Operations	$3,941,838	$1,639,825	$68,255	($222,538)	$5,427,380
New Mexico Operations	$5,967,732	$2,483,983	$69,655	($37,850)	$8,483,520
ALMA Operations	$178,213	$90	$10,882	$0	$189,185
Computer and Information Services	$469,146	$318,749	$8,041	$0	$795,936
Division of Science and Academic Affairs	$1,911,921	$270,625	$108,866	$0	$2,291,412
	$14,838,410	$9,710,509	$453,090	($413,909)	$24,588,100