

**Quarterly Status Update (QSU) Q4 FY 2011
July – September 2011**



Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Long Baseline Array



Agenda

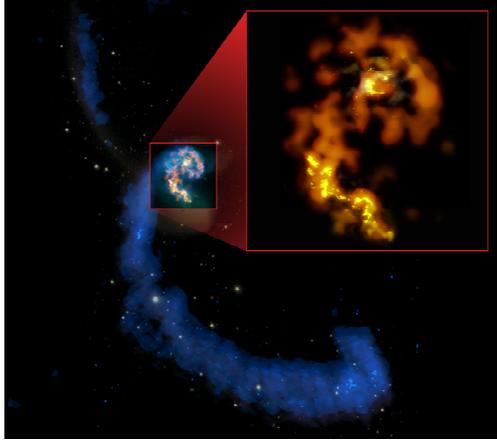
- Science Results
- Observatory Science Operations
- Observatory Telescope Operations
- Observatory Development & Programs
- Broader Impact
- Observatory Administrative Services
- Director's Office



ALMA Early Science Begins: 'Antennae' Science Verification Data

Inset:
ALMA's first mm/submm test views, in 3mm (orange), 1.3mm (amber), & .85mm (yellow) lines of CO, showing detail surpassing all other views at these wavelengths.

Large Image:
Multiwavelength composite of interacting galaxies NGC 4038/4039, the Antennae, showing their namesake tidal tails in radio (VLA HI: blues), past and recent starbirths in optical (whites and pinks), and a selection of current star-forming regions in mm/submm (orange and yellows).



 Chris Carilli 3

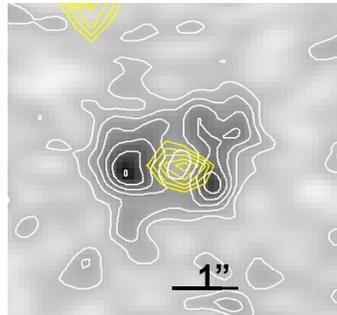
ABOVE: Multiwavelength composite of interacting galaxies NGC 4038/4039, the Antennae, showing their namesake tidal tails in radio (blues), past and recent starbirths in optical (whites and pinks), and a selection of current star-forming regions in mm/submm (orange and yellows). Inset: ALMA's first mm/submm test views, in Bands 3 (orange), 6 (amber), & 7 (yellow), showing detail surpassing all other views in these wavelengths.

CREDIT: NRAO/AUI/NSF; ALMA (ESO/NAOJ/NRAO); HST (NASA, ESA, and B. Whitmore (STScI)); J. Hibbard, (NRAO/AUI/NSF); NOAO.

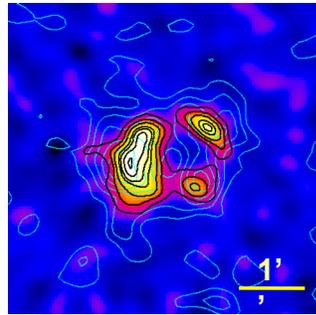
Science Results

-EVLA

Sub-Millimeter Galaxy MM18423+5938 at $z=3.93$ gravitationally lensed into an Einstein Ring.



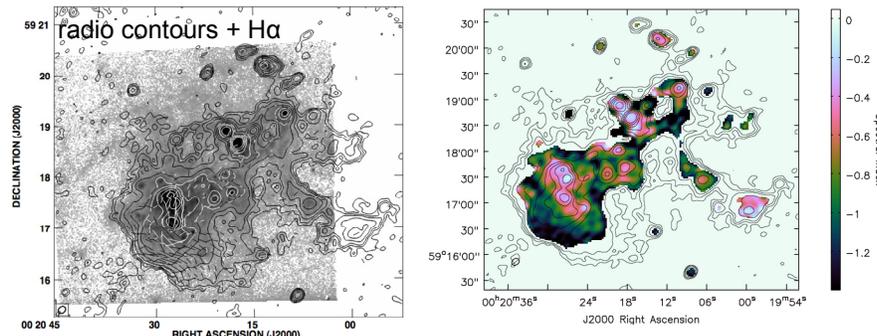
EVLA : CO(2-1) velocity-integrated map (greyscale)
CFHT : Lens galaxy at $z_{\text{photo}}=1.1$ (yellow contours)



IRAM/PdB : Dust emission in the 1mm band and EVLA CO(2-1) (contours)



IC10 = laboratory for studying star formation in dwarf galaxies
on 50pc scales



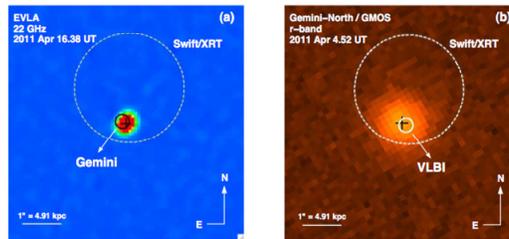
EVLA: wide-band allows total intensity + spectral index imaging

- 4-8 GHz emission traces H α closely \sim 1/2 thermal, 1/2 synchrotron
- SFR (radio/H α) suggests \sim 1/2 of CRs lost in outflow
- B fields confine cosmic rays in 'superbubble'



The Birth of a Relativistic Outflow in the Unusual γ -ray Transient Swift J164449.3+573451

Observations with the EVLA, VLA, Gemini, and the Swift gamma-ray telescope have revealed the birth of a relativistic jet due to a stellar accretion event onto a super-massive black hole. An unusual transient event was identified by Swift, and was observed with ground-based telescopes to obtain the position of the transient. These observations lead to a positional coincidence with the nucleus of an inactive galaxy, and provide direct evidence for a newly-formed relativistic outflow, launched by transient accretion onto a million solar mass black hole. While a relativistic outflow was not predicted in this scenario, the tidal disruption of a star naturally explains the high-energy properties, radio luminosity, and the inferred rate of such events. The weaker beaming in the radio compared to gamma-rays suggests that radio searches may uncover similar events out to redshifts of $z \sim 6$.



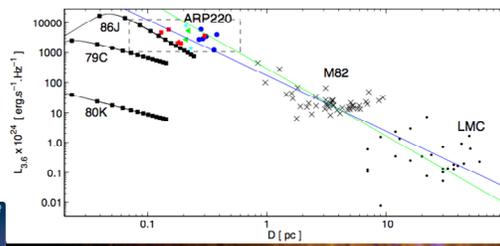
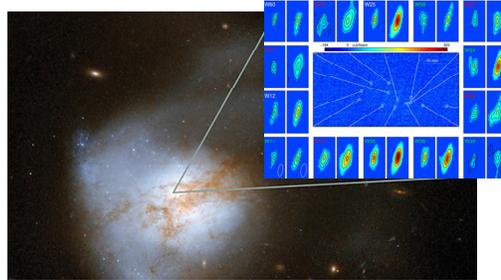
Images of Swift J1644+5734 and its host galaxy reveal a positional alignment between the transient and the center of the galaxy (Zauderer et al. Nature, 2011)



Resolution of the Compact Radio Continuum Sources in Arp 220

Batejat, F. et al. 2011, A&J

Monitoring of the most luminous ULIRG in the local universe, Arp 220, for over a decade using VLA, VLBA and GBT in global VLBI arrays reveal a supernova factory, imaged on subparsec scale. The SNRs can be resolved out from the SNe. They find magnetic fields strengths in the SNR shells of 15-50mG and concludes that the fields are internally generated.



Images and light curves of the SNR and SNe in Arp 220.



Science Results - GBT

GBT measures the metallicity of the Galactic Disk

The metallicity distribution in the Milky Way was derived from Green Bank Telescope observations of the electron temperature in 81 Galactic HII regions covering a range of 5-22 kpc from the Galactic center. A continuous radial metallicity gradient of -0.04 dex per kpc with no discontinuities is seen, but there is considerable azimuthal variation in metallicity at a given radius. These results imply that the ISM is not well mixed at a given distance from the Galactic center.

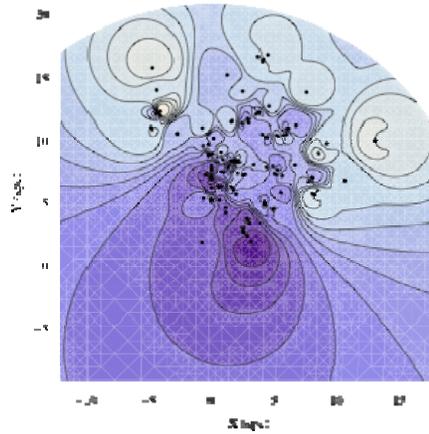
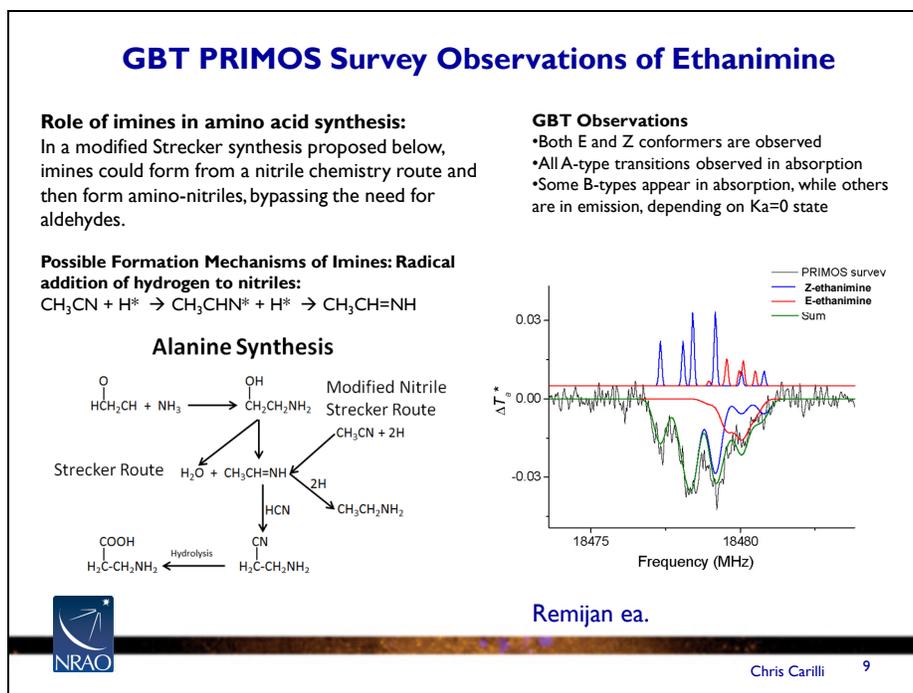


Figure caption: The distribution of nebular electron temperatures with contours ranging from 6400 to 11200 K in 400 K intervals. The darker shades are lower temperatures. The sun is at 8.5. Considerable azimuthal structure is seen at a given distance from the Galactic Center indicating an incomplete mixing of metals in the ISM. Balsaer, Rood, Banks & Anderson, 2011, ApJ, 738:27





The PRbiotic Interstellar MOleculE Survey (PRIMOS) began in 2007 and continues to be used by astronomers and chemists worldwide in unveiling the mechanistic chemistry of astronomical environments.

Most recently, NRAO scientists with their colleagues at the University of Virginia have detected one of the large interstellar “imines” ever detected using the GBT. These molecules, like so many others, are a mystery in how they are formed. Both laboratory experiments and computational chemistry theory indicate that the most favorable route to the formation of imines in astronomical environments may be hydrogen addition to radicals. This formation route is seen in laboratory discharge spectra and the measured abundances of already detected imines in astronomical environments support this hypothesis.

Imines may also be important to the formation of larger organic species like amino acids by a modified Strecker synthesis reaction. This method to the formation of amino acids is also supported by the recent detection of amino-acetonitrile toward the SgrB2N region. Yet amino acids have yet to be confirmed in the gas phase toward interstellar clouds.

The GBT observations, also toward the SgrB2N region, detected 2 structural isomers of ethanimine ($\text{CH}_3\text{CH}=\text{NH}$). All energetically favorable transitions were detected between Ku and Q band. Shown in the spectrum is the GBT data (black) and a model of the 2 ethanimine isomers in blue and red. When summed and given the correct line width, you clearly see the prediction (green gaussians) match the GBT spectrum exactly showing clearly this molecule detected in space.

Agenda

- Science Results
- Observatory Science Operations (OSO)
 - Shared Services
 - Facility-based Activities
 - Community Support Programs
 - Library/Historical Archives
- Observatory Telescope Operations
- Observatory Development & Programs
- Broader Impact
- Observatory Administrative Services
- Director's Office



Observatory Science Operations - Shared Services

- **Proposal Process**
 - NRAO call for proposals under new semester-based system went out on July 1 with a deadline of Aug 1.
- **User Portal**
 - Open sky contract was extended until Q3 FY12
 - Plans were made to advertise a programming position starting in Q1 FY12
- **Helpdesk**
 - Develop and implement integrated ALMA/NRAO helpdesk interface.

Tim Bastian/Tony Remijan w/ input from Chandler/O'Neil/Lonsdale11

As part of the new NRAO **proposal process** that is now under a semester-based schedule, the NRAO call for proposals (CfP) went out on July 1, 2011 with a deadline of Aug 1, 2011. The CfP included all of the NRAO North American facilities including the GBT, EVLA and VLBA. The new observing modes and instrumentation for these facilities were included in the Proposal Submission Tool (PST) that is accessed through the NRAO user portal at my.nrao.edu.

Re-insourcing the maintenance and development of **user portal** and PST software following termination of Open Sky contract was delayed until Q3 FY12 as we learned more about the issues related to the new semester based submission process. Plans continued for the re-insourcing of these software products as a job advertisement was developed in Q1 FY12 for a new programming position.

The development of an integrated ALMA/NRAO **helpdesk** interface was completed in Q4 FY11. Using an external Kayako module, NRAO and ALMA staff can view tickets submitted to both the NRAO and ALMA helpdesks through a common interface. In addition, tickets can also be transferred from one instance of a Kayako database to the other. Plans continue on a fully integrated NRAO/ALMA helpdesk using one instance of Kayako.

The Single Sign-On design work that will enable the helpdesk unification, as well as converged archive access, is a Q2 FY12 deliverable, but the proof-of concept for the association between NRAO (My.NRAO accounts) and NAASC (ALMA accounts) has been validated in Q4 FY11.

Observatory Science Operations

- Shared Services Cont.

- **Science Web**
 - **Migrate all content to new system for EVLA, VLBA, GBT, and NAASC**
 - All basic web content for EVLA and VLBA has been migrated to Plone with one exception.
 - The top level web pages for GB have been migrated to Plone.
 - Web content for NAASC has been migrated to Plone.
- **Science user outreach**
 - **Special issue of ApJL on EVLA early science**
 - The ApJL special issue on EVLA early science was published September 20, 2011.
 - ALMA Early Science began 30 Sept 2011.
 - Plans completed for Special Session and Splinter Session for ALMA at January AAS.
 - All lectures from the Sixth NAIC/NRAO school on single dish radio astronomy were placed online.

Tim Bastian/Tony Remijan w/ input from Chandler/O'Neil/Lonsdale12

As part of the restructuring efforts for the NRAO **science web** site, all content relevant to the EVLA, VLBA, GBT, NAASC and the CDL were migrated to a new content management system – Plone (www.plone.org). All basic web content for EVLA and VLBA has been migrated to Plone, with the exception of the Observational Status Summary documents, which will be done Q1 FY12. The top level web pages for Green Bank have been migrated to Plone, the existing link (<http://www.gb.nrao.edu>) will be redirected to the Plone site in Q1 FY12. All web content for NAASC specific material has been migrated to Plone and direct links to the ALMA science portal have also been included off the NAASC web page.

There were many events related to science **user outreach** that occurred in Q4 FY11. A special issue of ApJL on EVLA early science was published on Sept 20, 2011 which was comprised of 34 articles. Letters were sent to successful principle investigators of ALMA proposals informing them of next steps in the process of observing. Early Science for ALMA officially began Sept 30, 2011. Plans were also completed for Special Session and Splinter Session for ALMA at January AAS to highlight the results from the ALMA early science data and to prepare users for the ALMA Cycle 1 Call for Proposals which is scheduled for Q2 FY12. Finally all lectures from the Sixth NAIC/NRAO school on single dish radio astronomy held in GB were placed online.

Observatory Science Operations - Shared Services Cont.

- **VAO**
 - *Support VAO queries for metadata and raw data in NRAO archives*
 - Working with ALMA, EVLA, GBT to integrate VO-compatible metadata
 - Deploying NRAO VO servers for archive database and VO services
- **Metrics and Statistics**
 - *An automated metrics dashboard was designed and implemented.*

Tim Bastian/Tony Remijan w/ input from Chandler/O'Neil/Lonsdale13

VAO standards and protocols are persistently used to assist in getting information and metadata out of the NRAO archive and important large NRAO survey data products are queried using VAO tools. The NRAO archive access tool (AAT) can export VOTables with recorded metadata about processed and raw data files. The VLA image archive continues to use the Simple Image Access Protocol (SIAP) for its image cutout service. VAO user tool such as DataScope return standard NRAO products from the FIRST survey and return requisite catalog information.

To more easily return the requisite information concerning NRAO related **metrics and statistics** including, but not limited to, telescope time allocation, observing support programs and archive access for publications, a metrics database has been designed and implemented. The monthly update is automatic and the simple web interface to this metrics database is regarded as the metrics dashboard. Extensions to this service are planned for next year including historical information, reviewing and possibly extending content, improving the automation and improving the interface.

Observatory Science Operations

Facility-based Specific Milestones - Array Science Center (ASC)

- **Archives**
 - *Begin mirroring the EVLA archive to Charlottesville*
 - Problem with achieving required data rate, dedicated bandwidth from NM to CV is being investigated. EVLA archive mirroring delayed to FY12 Q4.
- **Observation support**
 - *Support in place for 2 GHz bandwidth observing on the EVLA*
- **User Education and Training**
 - *EVLA data reduction workshop held September 14-16*
- **Pipelines**
 - *Prototype EVLA pipeline developed in CASA by EVLA commissioning team*
 - ALMA and EVLA pipeline software development efforts combined

Claire Chandler w/ input from Brisken/Myers/Bastian/Langley/Perley14

All the software sub-systems are in place to support **2 GHz bandwidth observing on the EVLA**, and updated procedures for scheduling block verification have been developed for the D-configuration. Observing in the D-configuration began on September 26, 2011.

The increase in data rates and dataset sizes now available for all users in the D-configuration raised the need to educate EVLA users in the latest data reduction techniques. A **Data Reduction Workshop**, focusing on the new problems presented by wide bandwidth EVLA data, was held September 14-16, 2011. Its main aim was to expose experienced observers to challenges posed by the new, much wider EVLA bandwidths. The 36 participants (30 non-NRAO) had access to 20 high-end workstations to go through a number of CASA tutorials featuring EVLA data, assisted by local NRAO staff. An ALMA tutorial was available as well. A number of presentations by local staff covered several topics closely related to high bandwidth data reduction. Feedback from the participants was overwhelmingly positive, and provided ideas for the next Data Reduction Workshop, which is tentatively scheduled for February 2012.

A **prototype pipeline** reduction script for a restricted set of EVLA observing modes was developed by the EVLA commissioning team. It is currently being adapted for parallel processing in a cluster environment, which will be followed by performance testing. At the same time the ALMA and EVLA pipeline processing software development efforts were combined during Q4 under the leadership of the CASA manager, Jeff Kern, in order to exploit better the common elements of interferometric analysis.

Observatory Science Operations Facility-based Specific Milestones - ASC, Cont.

- **Science support software**
 - The Archive Access Tool was modified to support the shipping of data on disks
- **Face-to-face visitor support**
 - We supported 8 visiting scientists and 16 RSRO participants during Q4
- **Algorithm Development**
 - Test multi-scale, multi-frequency synthesis algorithms for wideband EVLA data; implement Faraday rotation synthesis algorithm in AIPS
 - Narrow-field, multi-scale, multi-frequency synthesis algorithms for wideband EVLA data were implemented in CASA release version 3.2 (Q3); a Faraday rotation synthesis algorithm was distributed in the 31DEC10 version of AIPS in (Q1)



Besides the release of the OPT for 2 GHz bandwidth observing, the other major development in the area of **Science Support Software** was the modification of the Archive Access Tool (AAT) in order to support the shipment of data to users on disk.

NRAO-Socorro supported 8 visiting scientists and 16 RSRO participants during the period July-September 2011. The summer months are typically the busiest for **face-to-face user support**, due to the summer break at universities.

Observatory Science Operations

- Facility-based Specific Milestones – ASC, Cont.

- **EVLA Commissioning**
 - Observation Preparation Tool modified to allow the preparation of observing scripts with 16 correlator sub-bands and up to 2 GHz bandwidth in anticipation of D configuration observing
 - Plan for disseminating large data sets implemented
 - Commissioning milestones achieved in Q4:
 - First science observations with variable bandwidth sub-bands
 - First pulsar observing with real-time de-dispersion using custom pulsar de-dispersion backend
 - Solar attenuators for observing the quiet Sun commissioned
 - Correlator data rates increased to 25 MB/s, 100 ms dump time for the full array achieves, and 40 ms dump times for a subset of antennas
- **Operations**
 - ~5000 ties will be replaced along the 44 miles of track
 - Array moved to different configurations
 - Visiting scientist quarters demolished



Claire Chandler w/ input from Brisken/Myers/Bastian/Langley/Perley

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The new version of the **Observation Preparation Tool (OPT)** supporting the increased number of correlator sub-bands being offered for the D-configuration, which began on September 26, 2011, was deployed in Q4. A **data distribution plan** was developed in Q1-Q3 and implemented in Q4. Data will continue to be available to users via FTP. However, many users have slow internet connections at their home institutions, so in the near term users are also able to request that their data be shipped to them on a disk drive.

Several **EVLA commissioning** milestones were met during Q4: (1) Variable bandwidth sub-band science observations were enabled for RSRO programs. This still requires some manual editing of observing scripts produced by the OPT, but the data acquisition system handles this well. (2) First pulsar observing with real-time de-dispersion using a custom pulsar de-dispersion backend developed by scientists in Charlottesville. When fully commissioned this backend will be made available to general users. (3) Solar commissioning of existing 20 dB solar attenuator for amplitude stability; some settling issues with the attenuators were found but this system will be fine for observing the quiet Sun until the solar-enabled receiver system is enabled. (4) Increased data rates (up to 25 MB/s) were made available to RSRO programs, and correlator dump times as short as 100 ms (for the full array) and 40 ms (for a subset of antennas) have been achieved.

Observatory Science Operations

- Site/center-managed Specific Milestones GBSO

- **Archives**
 - GBT on site data archive expanded to 400 TB and work continued to expand offsite storage facilities
- **Post Processing software**
 - Initial investigation into integrating the CASA single dish tools with GBTIDL undertaken
- **High Performance Computing**
 - Proposal to investigate HDF data format submitted to NSF
- **User Education and Training**
 - The sixth NRAO/NAIC school on Single Dish Radio Astronomy took place - July 11-15, 2011.
- **Pipelines**
 - Delivered final end-to-end pipeline for the GBT KFFA

Karen O'Neil17

In an effort to stay ahead of the continuing pace of data collection from the existing and new instrumentation on the GBT, the **on-site data archive** was expanded to 400 TB. In addition, work continued on improving network connectivity from Green Bank to allow for ready use of off-site data storage facilities.

An initial investigation on integrating the CASA **post-processing software** suite of single dish tools with GBTIDL was undertaken. In addition, the new instrumentation on the GBT will necessitate the use of **high performance computing** in the processes of data reduction and analysis. As such, a proposal to investigate the use of the Hierarchical Data Format (HDF, HDF4, or HDF5), which is the name of a set of file formats and libraries designed to store and organize large amounts of numerical data, for the GBT was submitted to NSF.

The Green Bank site continued its efforts in **user education and training**. The sixth NRAO/NAIC school on Single Dish Radio Astronomy took place from July 11-15, 2011 where approximately 80 attendees participated primarily from U.S. graduate schools. The objective of the school was to provide graduate students, post-docs, and experts in other fields of astronomy with both knowledge and practical experience of the techniques and applications of single-dish radio astronomy. The school was based around an intensive series of lectures from experts and a significant part of each participant's time at the school was spent analyzing the data acquired and interpreting the observational results from the GBT as well as with the Green Bank 40ft educational telescope.

In the last quarter, the GB software division released an end-to-end **pipeline** for the GBT KFFA. Plans also began for expanding the pipeline for most other GBT science observing modes.

Observatory Science Operations

- Site/center-managed Specific Milestones NAASC

- **Archives**
 - NAASC archive data synchronized with Chile, ready to serve Cycle 0 data
- **High Performance Computing**
 - Post-processing cluster was purchased for the NAASC
- **Observation support**
 - Scheduling Blocks for the first batch of NA ALMA proposals were generated
- **User Education and Training**
 - The outline for the on-line mm training course has been developed
 - Two new science verification data sets were released to the community
- **Pipelines**
 - ALMA Pipeline effort was consolidated into CASA
- **Algorithm Development**
 - Several algorithms for CASA reduction of ALMA early science data were implemented



Carol Lonsdale, Mark Lacy, Al Wootten

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To serve the North American user community, the NAASC has established a link with the **archive** in Chile. As such all the archive data are synchronized with Chile and ready to serve Cycle 0 data in Q4 FY11 and plans are in place to serve Cycle 1 data products by Q4 FY12. A large post-processing cluster as part of the **high performance computing** plan for the NAASC has been set in place to assist the user community for CASA data reduction and analysis. By the end of Q4 FY11, 8 processing nodes were in place at the start of Q4 FY11 and were being used by NAASC staff for internal testing of ALMA science verification data. In addition, 16 more nodes were purchased and were online by the end of Q4 FY11. Two Lustre servers were also in place at the start of Q4 FY11 and two more servers were purchased were online by the end of Q4 FY11. At the end of Q4, the total fast filesystem storage to archive ALMA data at the NAASC was 100TB.

Contact scientists in **support for ALMA observations** for each North American accepted proposal was established and scheduling blocks for the first batch (ie, batch 1) of NA ALMA proposals were generated by NAASC members of the phase 2 group (P2G). These NAASC members also took part in an extensive training session at the JAO in order to generate the phase 2 scheduling blocks. The NAASC also continued the efforts in **user education and training** by starting to develop an on-line mm-observing training course. NAASC staff also continued weekly discussions on interferometry techniques and data reduction as well as discussions on scientific programming with python. Finally, two new science verification data sets were released to the community and new casaguides were developed in support of these data sets.

The ALMA Pipeline effort was consolidated into CASA so that the algorithms and heuristics for both ALMA and EVLA are better integrated into CASA. Several **algorithms** for CASA reduction of ALMA early science data were also developed, implemented, tested and released to the community.

Observatory Science Operations

Community Support Programs

- **Undergraduate Student Programs**
 - Summer students
 - Twenty-nine students completed appointments as 2011 summer students
 - Activities included science research, observing experience with the GBT or EVLA, and attending the Single Dish Summer School
 - Twenty-two of the 2011 summer students will present their research at the January 2012 AAS meeting in Austin, TX
 - **Co-operative Education Students**
 - Two Co-Op students continued their appointments
 - **Undergraduate Internships**
 - Five undergraduates, all in Socorro, continued or completed undergraduate internships



Tim Bastian/Jeff Mangum 19

Summer Student Program: Twenty nine undergraduate and graduate students completed appointments as 2011 **summer students**. For more information on the program go to <http://science.nrao.edu/opportunities/summerstudents.shtml>.

Co-Op: Two **Co-Op students** continued their appointments: Utkarsh Sinha (SO) and Andrew Duncan (GB)

Undergraduate Interns: Five undergraduates (SO: 5) continued undergraduate internships working in the Electronics Division in Socorro: Natalie Kane, Deepak Rai, Cameron Welch, Orlando Lopez, and Loren Good (all SO).

Observatory Science Operations

- **Graduate Student Programs**
 - Graduate Student Internships
 - Four graduate students began or continued work as graduate interns with NRAO mentors
 - Reber Fellowship Program
 - University of Virginia student finished appointment working in Charlottesville
 - Shanghai Observatory student started appointment working in Charlottesville
 - New Mexico Tech student continued appointment working in Socorro
 - Student Observing Support
 - SOS Selection Committee received 24 proposals for observing support for the IIB observing term, 16 of which were granted observing time by the NRAO TAC
 - SOS Selection Committee awarded a total of \$167,549 to 7 SOS proposals
- **Visiting Astronomers**
 - One visitor at each of the three NRAO sites



Tim Bastian/Jeff Mangum 20

Four **graduate students** began or continued work as graduate interns with NRAO mentors. Paul Ries (UVA) is working with Todd Hunter on studying the long-wavelength characteristics of TNOs; Srikanth Bussa (University of Akron) is working with John Ford on research in digital signal process for the Green Bank telescopes; Dana Ficut-Vicas (University of Hertfordshire) finished her project working with Michael Rupen on the Little Things project; and Nimish Sane (Umd) is working with John Ford on a multiple frequency window processor for the GBT. Three graduate students participated in the **Reber Doctoral Fellowship** (formerly the Pre-Doctoral) program. Cheng-Yu Kuo (Univ of Virginia) finished his PhD research and Feng Gao (Shanghai Observatory) started his PhD research. Both students were working with Jim Braatz in Charlottesville on reducing and analyzing VLBI observations of water maser emission from galactic nuclei as part of the Megamaser Cosmology Project. Josh Marvil continued his appointment as a Reber Fellow this quarter working with Fraser Owen. The **Student Observing Support** (SOS) committee recommended funding a total of \$167,549 to 7 of the 24 proposals submitted (only 16 of which were allocated observing time and considered for SOS funding) this period. They are as follows: GBT IIB-126, supervisor, Stuartt Corder, student Adele Plunkett, Yale University, for \$34,495; GBT IIB-027, supervisor Martha Haynes, student Gregory Hallenbeck, Cornell University, for \$35,000; GBT IIB-066, supervisor Dan Werthimer, students Siemion/Wharton/Chennamangalam, Berkeley/Cornell/WVU, \$7,500; GBT IIB-001, supervisor Mark Devlin, student Tony Mroczkowski, University of Pennsylvania, \$35,000; GBT IIB-053, supervisor Tony Remijan, student Joanna Corby, University of Virginia, \$3,000; GBT IIB-051, supervisor D J Pisano, student Spencer Wolfe, WVU, \$29,184; VLA IIB-156, supervisor Lawrence Rudnick, student Damon Farnsworth, University of Minnesota, \$23,370. There were three **visiting astronomers** this quarter. Yancy Shirley of University of Arizona visited NRAO CV for the month of June 2011. D.J. Pisano of WVU completed a two-month visit to NRAO GB in Junly and August. Andreas Brunthaler from MPIfR began a one-year visit to NRAO SOC in June 2011.

Observatory Science Operations

- **Library**
 - This quarter, the NRAO Library began lending eReaders to our users.
 - Have put new emphasis on archival quality digitization of all NRAO publications.
 - The NRAO Library has expanded the FAQ page.
 - The new version of NRAOPapers went live this quarter.



Marsha Bishop, Lance Utley, Megan Nunemaker 21

This quarter, the NRAO Library began lending **eReaders** to our users. These can be borrowed the same as books. This was done to facilitate the use of our extensive (over 15,000 titles) eBook collection.

In addition, we have put new emphasis on **archival quality digitization of all NRAO publications**, including reports, memos, workshops, conferences, and other miscellaneous NRAO publications. The archive quality digitization will ensure historical materials are not only available now in print and online, but will ensure their availability in the future as formats change.

The NRAO Library has expanded the **FAQ** page to make the NRAO Library web page more user friendly.

The new version of **NRAOPapers** (the NRAO bibliography) went live this quarter. It's been vetted and works extremely well.

Observatory Science Operations

- **Historical Archives**

- Processing was completed on the additional materials donated by A. Richard Thompson.
- New Mexico Site Director's Office back files were reviewed and shipped to CV for integration into existing archives.
- Beginning work on material donated to the Archives by Bernard F. Burke.
- Work was completed on digitizing Sullivan's audio-taped interviews with the help of student intern funded by the Dudley Observatory Pollock Award.



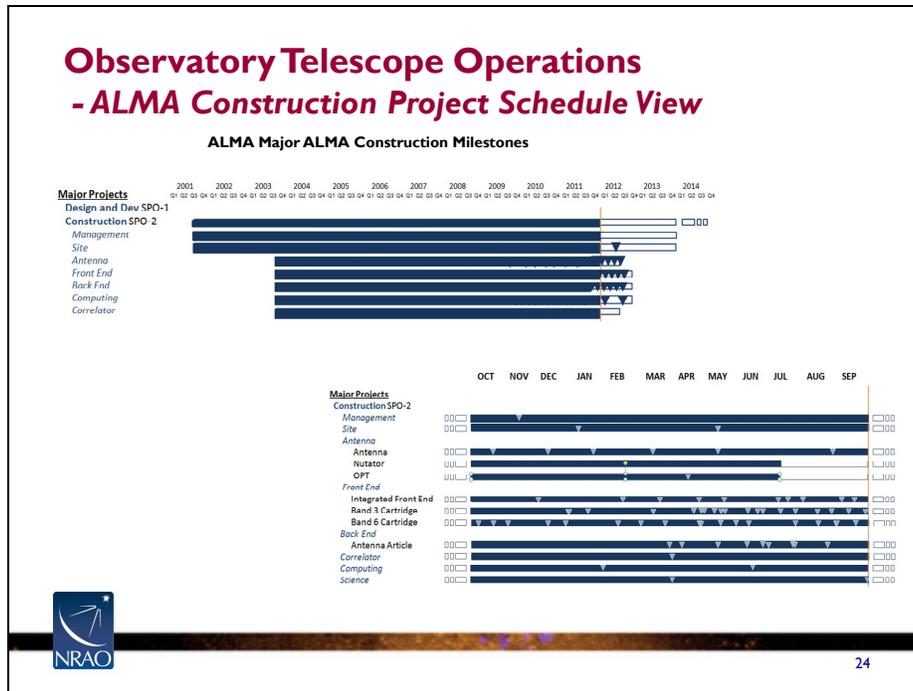
Processing was completed on the additional **materials donated by A. Richard Thompson**. **Miller Goss reviewed New Mexico Site Director's Office** back files stored for many years at the VLA site and shipped approximately 15 banker boxes of material to the Archives; they will need to be reviewed and integrated into the existing NRAO records collection. A **preliminary inventory of the material by Bernard F. Burke** was completed and processing work has begun on 16 banker boxes of material donated to the Archives.

The most significant work during this quarter was on the **Papers of Woodruff T. Sullivan III**. The summer student in the Archives, funded by Dudley Observatory's Pollock Award to Archivist Ellen N. Bouton, completed digitization of all 173 audio tapes, which include interviews with 255 20th century radio astronomers, as well as a number of lectures, meeting talks, and conferences on radio astronomy history and SETI. The student began the work of obtaining permissions from interviewees or their heirs to make the interviews available to researchers, and did significant work on creating the suite of pages providing Web access to the collection. Since the student's departure, work has continued on obtaining permissions, the Web pages have been completed, and Sullivan's working files have been fully processed. Further work is necessary on the permissions, on review and quality control of the digital files, and on possibilities for making written transcripts and/or audio files available on the Web. Processing of the additional materials expected from Sullivan will continue as they are received. Finding aids for the Archives collection and the Archives online catalog are linked from the NRAO Archives home page, <http://www.nrao.edu/archives/>.

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 - EVLA Construction
 - EVLA/VLBA Operations
 - Green Bank Operations
- Observatory Development & Programs
- Broader Impact
- Observatory Administrative Services
- Director's Office





The first graph illustrates the full lifecycle. The second graph is this fiscal year view. The vertical line represents where we are today.

Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Management**
 - Conduct Annual External Review [Q1]
 - AAER completed in Q1
 - NRAO/AUI instituted a program to improve safety in the conduct of its work at the ALMA site.
 - Recruitment of two NRAO Safety Officers for the ALMA site was completed in September



NRAO/AUI instituted a program to improve safety in the conduct of its work at the ALMA site. The program involves placing two safety officers, one per 8x6 shift at the site. The primary focus of the safety officers is the work performed by local Chilean companies under contract with AUI. The safety officers will not be involved with the work conducted by the other ALMA Executives. The recruitment ended in September 2011 with the recruitment of the two Safety Officers, one starting in September and one in October.

Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Site**
 - Complete antenna stations, phase IV [Q4]
 - Phase IV stations completed in Q4
 - Acceptances scheduled to be completed in Q1 FY12.
 - AOS Utilities work restarted fully in Q2 FY2011 and will continue until Q2 FY12
 - Delayed from Q4 FY11 due to uncharacteristic bad weather.
 - Legal proceedings with the former contractor and the insurance company holding the performance bond are in progress
 - Execute the contracts for AOS road construction [Q4]
 - Scheduled to be completed in Q1 FY12. Also delayed due to weather

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Site: The **AOS Utilities contract** was delayed due to the termination of the former contractor on June 30, 2010. The new contract work restarted on site on January 3, 2011. The milestone in the ALMA schedule to deliver phase 4 stations for Early Science was met by a partial delivery in July and the rest was finished in September 2011. Acceptance of the complete Central Cluster (CSV Phase IV) is ongoing and expected to be complete in October 2011. The next milestone is the 5 km Array, scheduled for Q1 FY2012. Bad weather at the AOS has further delayed the completion of the AOS Utilities work, but the delay should not affect the overall completion of the project. The Utilities Contract work is 49% complete. Legal proceedings with the former contractor and the insurance company holding the performance bond are in progress.

AOS road construction work is 90% complete. This contract restarted in October 2011 after the winter break. To date, all roads are already cut or filled to subgrade level and the remaining work is to achieve the final level in the subgrade and install the crushed gravel in the loading area of the antenna stations. This contract is scheduled to finished in Q1 FY2012. Recent bad weather also delayed the road completion, but this did not affect the start of Early Science in 2011.

Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Antenna**
 - Vertex antenna acceptance [Q1, Q2, Q3, Q4]
 - Vertex antenna #15 fully-accepted and delivered to the JAO (August)
 - Vertex antenna #16 fully-accepted and delivered to the JAO (September)
 - Vertex antenna #17 will be ready for acceptance in mid-October
 - Deliver nutator unit #1 through #5 [Q1, Q3]
 - Optimization of control software continued on unit #1 in Green Bank
 - Factory Acceptance Test (FAT) of nutator unit #2 expected in Q1 FY2012
 - Delivery to OSF in mid-Q1 FY2012
 - Delivery of additional 4 units through Q3 FY2012
 - Complete delivery of 6 OPTs [Q2]
 - Independent review of OPT design iteration #3 to be conducted following review with JAO
 - To be delivered in late Q1 FY2012 or early Q2 FY2012



Antenna: The **15th** and **16th** **Vertex antennas** were fully accepted into the JAO. Pointing acceptance testing began at the end of September on the **17th** **Vertex antenna** (following a 1-week delay caused by an ALMA software issue). Integration, commissioning, and acceptance testing on the **18th** **Vertex antenna** is also nearing completion with acceptance of the antenna by the JAO expected Q1 FY2012. Vertex and NAAIPT continue to work with AIV to provide a high level of antenna availability; efforts continue to concentrate on resolving issues related to encoder and tiltmeter faults. Root cause of **tiltmeter faults** has been identified and an upgrade by the vendor is being instituted; root cause of **encoder faults** has been isolated by the vendor but not completely resolved at this time.

Nutator: Optimizing the performance of the servo control system has continued to be problematic but tandem efforts in **Green Bank** with the first nutator unit and in Taiwan with the second nutator unit are converging on a satisfactory solution. Factory Acceptance Testing (FAT) is now expected to take place in Taiwan using the second nutator unit as expected in early Q1 FY2012. With a successful FAT, **delivery of Nutator Unit #2** to Chile would be in mid-Q1 FY2012 for on-site engineering and interface tests (PAS). Production OPT (POPT): For Unit #3, the **POPT contractor** had developed an alternate design configuration incorporating a new doublet lens, CCD, and focusing mechanism. Following a review of this Design Iteration #3 with JAO, an independent assessment of the design was undertaken with a consultant in Tucson; a preliminary summary report has been received from this independent assessment and a joint NAAIPT/JAO review should be completed in early Q1 FY2012 to allow OPT production to proceed with the Design Iteration #3 configuration. **Unit #2** continues to be used NRAO/Vertex to perform acceptance testing on Vertex Antennas (used for #15 through #17 Pointing Acceptance Tests. AIV discontinued repeating Optical Pointing verification efforts in Q4; therefore, POPT **Unit #1** has been upgraded with a version of the CCD planned for Design Iteration #3 and the Unit is acting as backup for NAAIPT Pointing Acceptance efforts. **Risk:** Delayed delivery of the POPT potentially risks prompt delivery of EU and NA antennas. **Mitigation:** Proceed with production of Design Iteration #3 as soon as the Independent Assessment is validated by NAAIPT and JAO reviewers.

Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Front End**
 - Deliver Integrated Front Ends to OSF [Q1, Q2, Q3, Q4]
 - FE #9, 10 & 11 delivered to OSF (50% complete)
 - FE #12 & 13 in test; FE #14 assembled and awaiting test; FE #15 & 16 in assembly
 - Software revisions underway to further improve automation of FE tests
 - Deliver Warm Cartridge Assemblies [Q1, Q2, Q3, Q4]
 - On schedule (93% complete)
 - Deliver Cold Cartridge Assemblies (CCAs) for bands 3 and 6 [Q1, Q2, Q3, Q4]
 - Band 3 on schedule (88% complete)
 - Band 6 behind schedule (64% complete) due to low mixer yield and corrective maintenance issues. Steps taken to improve mixer yield and CCA reliability
 - Deliver FE Components [Q2, Q4]
 - All baseline component deliveries will be complete by December 2011. Bias Modules (except B10, 100% complete); FE M&C Kits (90%); Compressor M&C Kits (84% complete); Power Supply M&C kits (100%).
 - Design of the Thermal Interlock Module (TIM) is nearly complete


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Delivery of 14th NA Front End (FE) was delayed primarily due to Band 3 and Band 6 CCA problems requiring removal, replacement, and re-test of the malfunctioning CCAs. **Risk:** Delayed delivery of FEs to the ALMA site. **Mitigation:** Improve CCA reliability (see below).

Band 6 CCA mixer production yield continues to be an issue. **Risk:** poor yield delays delivery of B6 CCA to FEICS for FE assembly. **Mitigation:** A second mixer preamp subassembly line was implemented and an audit for electrostatic discharge (ESD) is being made. A research engineer has been appointed to review assembly procedures. An internal review is scheduled for the first week of November. Total B6 CCAs delivered: 57 (78% complete). Ten B6 CCAs have been returned for repair due to excessive oscillations and cracked mixer chips. Total functional B6 CCAs available to the project is 47 (effectively 64% complete). **Risk:** delayed delivery of assembled FEs to Chile. **Mitigation:** prescreen B6 CCAs for excessive oscillations and don't use what was found to be defective material in mixer assembly.

Components: All Band 10 bias modules will be delivered during Q1 FY 2012. The final 4 production FE M&C kits will be delivered to EU FEIC during Q1 FY2012; 3 spare kits will be delivered to the JAO during Q1 FY 2012. The Compressor M&C Kits are delayed slightly due to late delivery of its components, but this will not impact ALMA science operations. A preliminary design verification test of the prototype TIM in the NA FEIC is scheduled for the last week of October. Final design verification testing of the TIM is tentatively scheduled at the OSF and AOS during the last half of November.

Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Back End**
 - Deliver CLOA2 to AOS [Q2]
 - Complete
 - Deliver antenna articles to OSF [Q1, Q2, Q3, Q4]
 - The last 6 Antenna Articles (61-66) were completed and tested in Q4
- **Correlator**
 - Deliver quadrant 4 [Q2]
 - Delivery was delayed to July 2012 to allow continuation of correlator software testing.
- **Computing**
 - ALMA software release R8.0/R 8.1 [Q1, Q3]
 - R8 was deployed in January 2011
 - Patch R8.0.3 will be used for early science
 - R8.1 was deployed in July 2011 for routine CSV use

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BACK END: Antenna Articles 61-66 (final baseline deliverables) were tested and passed in Q4. At this point the IPT is focusing on building all components remaining from production of all articles and delivering the spares to the ALMA sites.

CORRELATOR: Quadrants 1 and 2 are configured for 2-quadrant operation, servicing up to 32 antennas for CSV and for early science. Quadrants 3, at the AOS, and 4, in Charlottesville, are in use for firmware and software verification as more functionality is added. Quadrant 4 is undergoing PAI testing. Our plan is to start disassembly in January, 2012 and to have a fully operational 4-quadrant correlator, capable of servicing 64 antennas, in July of 2012. Presently, quadrant 4 is extremely useful as a test bed for activating new features and for debugging problems found by CSV. The delayed delivery of quadrant 4 currently poses no risk to budget or schedule.

COMPUTING: Release 8.0 of the **ALMA software** was deployed in January 2011. R8.1 was deployed in July 2011 for routine CSV use, however preparation for Early Science and some residual problems delayed the point at which CSV shifted to full use of R8.1 into September. The decision about whether to use R8.1 for the remainder of Early Science is intended to be made (at JAO) at about the time of the February 2012 shutdown.

Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Science IPT**
 - Issue call for proposals [Q1]
 - Call issued March 30, 2011
 - Start of early science [Q4]
 - Early Science Cycle 0 started 30 September 2011 as planned.
 - Press release issued October 3: <http://www.nrao.edu/pr/2011/almaearlysci/>

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SCIENCE: The Plan for ALMA Early Science Cycle 0, which was announced at the end of Q2 FY 2011, is on schedule. The Science IPT participates in an Imaging Tiger Team at the NAASC which works with the CSV imaging team through analysis of ALMA data to verify performance of the array. A further science verification image, of the Antennae galaxies, was released during Q4 2011; a CASA guide is available for those wishing to access, calibrate and image the data. This data was used in a press release issued in Q1 2012 announcing the beginning of Early Science.

Science IPT members work with the NA antenna contractor to test newly assembled antennas before delivery to ALMA. They also help to debug antenna problems uncovered by ALMA. Science IPT members also referee submissions to the ALMA Memo Series, of which there were two during 2011 Q4.

Observatory Science Operations
- Site/center-managed Specific Milestones NAASC

- **Commissioning – ALMA**
 - Commissioning of 16 antennas, 4 bands
- **Operations – ALMA**
 - Start of Early Science Observations
 - ANASAC f2f meeting

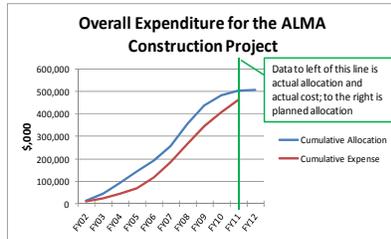


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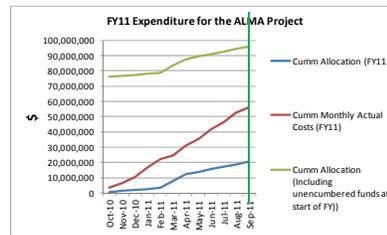
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ALMA successfully completed the commissioning of 20 antennas in 4 bands. Start of Early Science Observations 30 Sept; one day in this quarter. Of those proposals observed on that day, North American proposals were among them. ANASAC f2f meeting held 28-29 September at NAASC.

Observatory Telescope Operations - ALMA Construction Financial Performance Graphs - overall & Q4 FY2011



Overall Spending for the ALMA Construction Project



FY11 Spending for the ALMA Construction Project



Both graphs show the **NSF budget allocation**. In the case of the overall plan, the cumulative allocation is the allocation actually provided by NSF up to the end of FY2011, plus the planned allocations in FY2012.

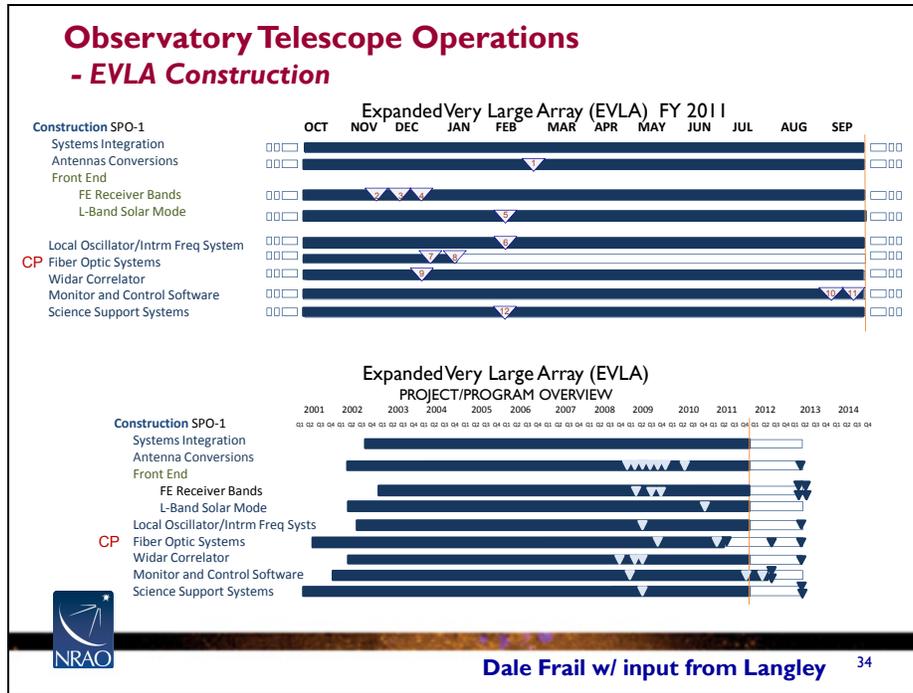
Observatory Telescope Operations - ALMA Construction Significant Events-Japan Partnership

- NAOJ delivery of Band 4 & 8 CCAs delayed due to pending requests for waiver.
 - NA FEs #9, 10, and 11 shipped without B4 CCAs
 - NA FE #11 shipped without B8 CCA.
- Four additional Band 4 WCAs delivered this quarter.
 - Total delivered: 47 (64% complete)
- Six additional Band 8 WCAs delivered this quarter.
 - Total delivered: 49 (67% complete)
- Two pre-production Band 10 WCAs delivered to the NAOJ for performance evaluation.



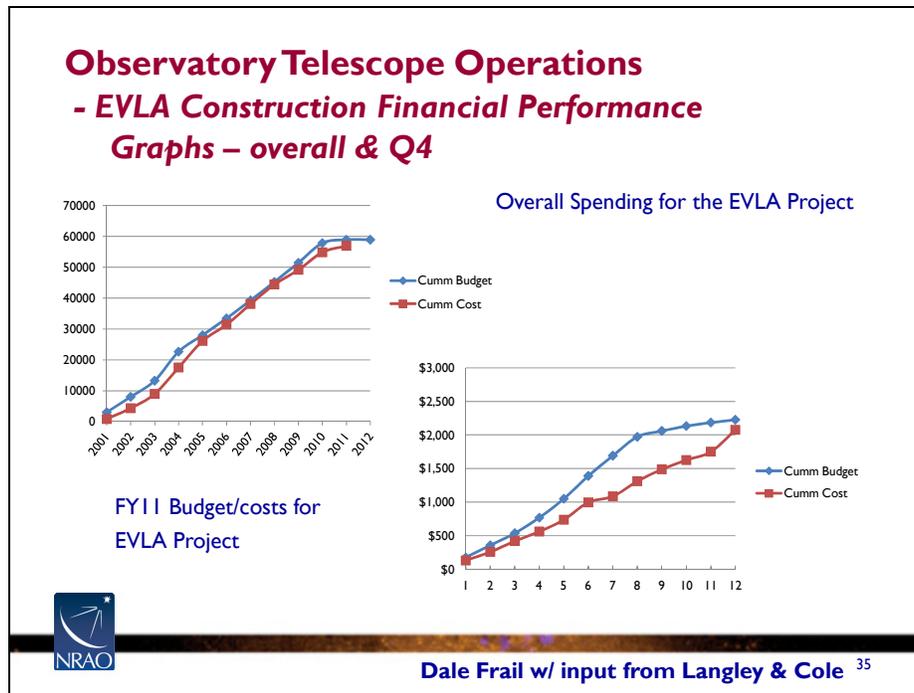
Overall, the delivery of Bands 4, 8, and 10 is coming later in the project than the delivery of the baseline Bands 3, 6, 7, and 9 due to Japan's late entry in the project. An integration plan for Band 4, 8, and 10 CCAs is under development. This work will occur at the OSF. NA FEs #9, 10, and 11 included Band 4 WCAs; NA FE #11 included a Band 8 WCA.

A formal Statement of Work covering the transferred production of five FEs from the NA FEIC to the EA FEIC was delivered to the EA FEIC.



The top graph is this fiscal year view. The bottom graph illustrates the full lifecycle. The vertical line represents where we are today. The CP represents the critical path.

The Fiber Optic System remains on the critical path due to the delay in the installation of the 3-bit samplers (milestone 8). Installation of the prototype L-Band Receiver (milestone 5) has occurred, and testing is ongoing.



Cumulative cost depicted in the lower right hand (red) plot lines will always be below the budget due to contingency, which is spent as required.

The FY2011 budget was adjusted during Q4, resulting in some funds being carried over into FY2012. Front End spending was lower than planned due to L-band enhanced solar observing capability not yet being in production. Computing was under-spent due to a conscientious effort not to purchase archive hardware until it is needed. By delaying this, we anticipate receiving more value for the dollar (higher quality hardware).

Several items were funded out of contingency in Q4. RF switch funds totaling \$309K (for labor and parts, most of which were carried over into FY2012), additional support for 3-bit implementation (approximately \$15K), higher capacity transporter generators (\$80K), a one year extension for the project Mechanical Engineer (\$87.4K), \$60K allocated for the EVLA dedication ceremony (EPO, carried over to FY12), \$40K for the EVLA Visitor's Center (EPO, carried over to FY2012), and a one year extension for a computer programmer (\$73K) were all approved by the EVLA Change Control Board. Despite these expenses, project contingency remains at a healthy level. It is actively managed and is expected to be expended by the project closure date. The project contingency vs. cost to complete presently stands at approximately 20%

Observatory Telescope Operations

- EVLA Construction

- **Front End Receiver Bands**
 - L-, S-, X-, and Ku-Band receiver installations remain on schedule for completion by the end of CY2012.
- **Front End L-Band Solar Mode [5]**
 - Prototype receiver installed on antenna, tests are ongoing
- **Fiber Optic [8]**
 - Twelve 3-bit, 4 Gbps first article samplers installed on six antennas in Q4 FY2011
 - Check-out in full EVLA system ongoing in October 2011
 - Recovery schedule implemented, no delay to finish of construction

Dale Frail w/ input from Langley 36

NOTE: [numbers] refer to corresponding numbers on the EVLA milestone chart in the FY2011 POP. The Front End L-band and Fiber Optic 3-bit deployment are currently running behind schedule. Risks and Mitigations are defined below.

Engineering development work proceeded on the **first receiver with solar observing capability [5]**, originally due in FY2011 Q1. Prototype testing in the lab continued in Q4. A setback occurred in late Q4 when the receiver malfunctioned, resulting in damage to a critical component. The receiver has since been repaired, lab testing has resumed, and installation on an antenna has taken place. Testing is ongoing. **Risk:** Minimal risk – issues during the prototyping process have largely been overcome. The milestone will be satisfied when the L-Band prototype is deployed and undergoes testing.

Begin installation of 3-bit/DTS modules [8] in Q2 was delayed as a result of the redesign and delay in sampler assembly testing. The installation of the first twelve production 3-bit/DTS modules took place in Q4. Complete production of assemblies and an installation schedule has been re-examined, and the risk to an on time project completion is minimal. **Mitigation:** If necessary, use a modest amount of contingency funds to accelerate the installation schedule by extending existing key ALMA staff who are already familiar with the DTS module.

Observatory Telescope Operations - EVLA Construction

- **Correlator [9]**
 - WIDAR on-the-sky test plan written. Presently with DRAO for final modifications
- **Monitor and Control [10 & 11]**
 - OSRO observing w/ 2 GHz bandwidth complete
 - Final antenna retrofitted for updated monitor and control, WyeComm no longer required for antenna operation
 - 3-bit operation supported by EVLA executor and correlator software (FY2012 Q1 milestone 11 completed early)



NOTE: [numbers] refer to corresponding numbers on the EVLA milestone chart in the FY2011 POP.

Finalization of the WIDAR acceptance plan [9], milestone was previously divided into two parts: Hardware acceptance and on-the-sky acceptance. The hardware acceptance plan has been completed since Q1. A high level draft of the on-the-sky acceptance plan is written and only lacks final input from DRAO. Both plans are being implemented in conjunction with the correlator being exercised continuously.

Observatory Telescope Operations

- EVLA Operations

- **Railroad Infrastructure Maintenance and Repair**
 - Railroad Tracks - ~5,000 ties will be replaced along the ~44 miles of array tracks [Q1, Q2, Q3, Q4] **Not complete**
 - Total track work completed for FY2012 included the following:
 - Replaced switch ties, completing 9 switches ; Installed 4 Intersections; Fabricated & Poured & Assembled 4 sets of Timbers; 400 Switch ties Installed; 1388 Regular ties Installed; Washouts addressed.
- **Antennas**
 - Antenna 23 overhauled; Antenna 25 Azimuth bearing replaced. Q4
- **Radio Frequency Interference Mitigation**
 - Began examining wider swaths of spectrum for internal RFI
- **Array Configuration change**
 - Re-configuration to D configuration was completed in Q4
- **Other Operations Activities**
 - Weather Station tower erected; Completion date Q1 FY2012 for package installation and software
 - Control Building East exterior staircase repair is on-going
 - Replacement API parts purchased.



Dale Frail w/ input from P.Perley 38

The 5000 ties/year goal was not met by Q4 due to concerns that we would not get the new ties in place before the A->D array moves, delaying that effort. Manpower shortages also contributed to the lower than usual tie replacement. Additionally, the Track Crew fixed broken timbers and splice bar bolts prior to the antenna moves. Track crew also hauled fill dirt to the east arm to build out a Bank that was pretty steep. The ballast was washing down the hill side.

Observatory Telescope Operations

- VLBA Operations

- **Infrastructure Maintenance and Repair**
 - Major Maintenance Tiger Team Visit to SC completed in Q4
 - Replacement of Azimuth wheel assembly occurred at BR in Q4
 - C-band feed replacement at BR, SC completed Q4
- **Partnerships**
 - Installation of fiber-optic connections between MK and PT and the USNO correlator in Washington, DC completed
 - PT fiber installed and successfully tested
 - MK fiber installed and successfully tested(Q4)Installation of fiber-optic connections between MK and PT and USNO
- **NTC**
 - Provided LNAs for C-band receiver upgrade.



Observatory Telescope Operations

- Green Bank Operations

- **Infrastructure Maintenance and Repair**
 - GBT summer maintenance schedule dominated Q4
 - 50% larger painting crew yielded record 12.6% coverage and twice the usual number of primary panels painted (96)
 - Completed scheduled maintenance of drive motors and brakes
- **Site activities**
 - Scientific, operational, and logistical support for summer school students.
 - Parts and assemblies for the Skynet X-Band receiver, EVLA, VLBA, and 4mm receiver fabricated Central Instrument Shop in Green Bank
 - Interactive science activities at Open House on Sept. 18 attracted area students.

Karen O'Neil w/ input from Holstine 40

The **GBT summer schedule** of four ten-hour maintenance days per week was in place for July and August. All of the maintenance goals established for the season were accomplished. Of particular success was the aggressive amount of structural and primary surface panel painting accomplished due to the addition of extra paint crews and selected overnight shutdowns that added 1-3 hours of productive painting to the days adjacent to the shutdown. This painting strategy will be duplicated in upcoming years.

In Q4 FY2011, the GB Machine Shop fabricated parts and assemblies for Green Bank projects Skynet X-Band receiver, and 4mm receiver (50.7% of shop time). Work for non-Green Bank projects includes EVLA and VLBA (49.3% of shop time).

The Green Bank Open House was held on September 18. The event was marketed as "Family Science Day" and was targeted toward local families, specifically those with elementary and middle school students; the turnout from these groups was excellent. In addition to site tours and demonstrations, the Science Center offered twelve hands-on activities that allowed participants to conduct experiments and build items to keep.

Observatory Telescope Operations

- Green Bank Operations

- **GBT Operations**
 - Multiple Ka-band pointing runs and azimuth track maps were executed, including a set following September earthquake.

- **Green Bank and the National Radio Quiet Zone**
 - Executed a replacement MoU with NAIC in Sugar Grove for NRQZ administration
 - Stepped-up internal initiative to mitigate sources of interference in Jansky Lab and other RFI Interference Zone #2 locations

Karen O'Neil w/ input from Holstine 41

Multiple **pointing runs and azimuth track maps** were executed around the GBT summer track work and the August earthquake. All results show the tracking and pointing remains stable.

A new Memorandum of Understanding was executed with NAIC (Navy Information Operations Command) for **NRQZ administration**. A series of equipment shutdown tests and measurements throughout the Jansky Lab have identified **sources of interference** from networking, business machines and other electronic devices. The shielding efficiency of the GBT Control Room was re-measured and verified to still meet EMI specifications.

Agenda

- Science Results
- Observatory Science Operations
- Observatory Telescope Operations
- Observatory Development & Programs (ODP)
 - VLBA
 - Green Bank
 - Coordinated Development Laboratory
 - New Initiatives Office
- Boarder Impact
- Observatory Administrative Services
- Director's Office



Observatory Development & Programs (ODP)

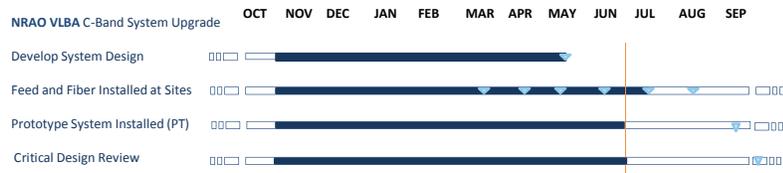
- VLBA

- **VLBA Performance & Capability Enhancements**
 - Demonstration of 4 Gbps observing [Q4] **not met / deferred indefinitely.**
 - First successful engineering tests of the digital downconverter personality occurred [Q4] (was Q1)
- **VLBA C-band System Upgrade**
 - Will provide frequency coverage of 4.0-7.9 GHz; enables access to the 6.7 GHz methanol maser line for Galactic parallax measurements
 - Requires new feeds, receivers, IF downconverters, and M&C system
 - Status:
 - New receivers were installed at FD and OV in Q4.
 - Two additional antennas (SC and BR) have been outfitted with upgraded feeds in Q4 and are awaiting upgraded receivers
 - Nominal completion date for this project is end of FY2012

Dale Frail w/input from Brisken 43

4 Gbps observing was not yet demonstrated. While it could have been demonstrated with existing hardware, the demonstration would have been a large distraction, taking folks away from the higher priority stabilization of the 2 Gbps system. The optimal way to achieve 4 Gbps has not yet been identified. An internal ODP proposal to pursue this path was not accepted. While some demonstration at 4 Gbps may be attempted during FY2012, such a feat will be somewhat pointless until funds to deploy such a system array-wide are found.

Observatory Development & Programs - VLBA Development Specific Milestones



The first graph illustrates the full lifecycle. The second graph is this fiscal year view. The vertical line represents where we are today. The CP represents the critical path.

Observatory Development & Programs - Green Bank

- **Green Bank Telescope**
 - **MUSTANG2:**
 - Pursuing external funding.
 - **KFPA:**
 - Completed.
 - **CICADA-FPGA-based Spectrometer (VEGAS)**
 - Modes and supporting infrastructure designed.
 - **PTCS:**
 - Control Kernel complexities delay servo replacement into Q2FY12.
 - The journal paper on GBT traditional holography appeared in the September 2011 issue of PASP.



MUSTANG2: Proposals submitted to the ODP were not ranked high enough for FY2012 NRAO-internal development resources. The team will seek outside funding for the project.

K-Band Focal Plane Array (KFPA): The **KFPA** receiver is in full use by GBT observers.

CICADA/FPGA Spectrometer (VEGAS): **VE**rsatile **GBT** **A**stronomical **S**pectrometer. Work is progressing on the first deliverable of one mode on one spectrometer in Green Bank in Q1 FY2012. Construction and hardware fabrication is underway on the IF routing, clock routing, and signal switching systems. GB-developed Monitor and Control software for the spectrometer has been tested with a VEGAS simulator.

Precision Telescope Control System (PTCS): Unanticipated complexity of the control kernel has delayed the final two integration iterations (#5 & #6). Integration #5 is in lab acceptance testing, but Integration #6 will not be ready until late in Q1 FY2012. Much of the GBT hardware has been installed and tested, but complete installation has been de-prioritized in lieu of other more important activities, pushing it past the Q4 Milestone, but still allowing for completion prior to the GBT tests. **Risk:** The final commissioning of the replacement servo will be delayed into Q2 FY2012 and the follow-on performance improvements also delayed by a similar amount. **Mitigation:** A second digital electronics supervisor has been added to the project to independently assess the scope and complexity of remaining kernel work. Only the testing phase remains and compressing or de-scoping is a risk believed much worse than the delay in completion.

Observatory Development & Programs

- Green Bank

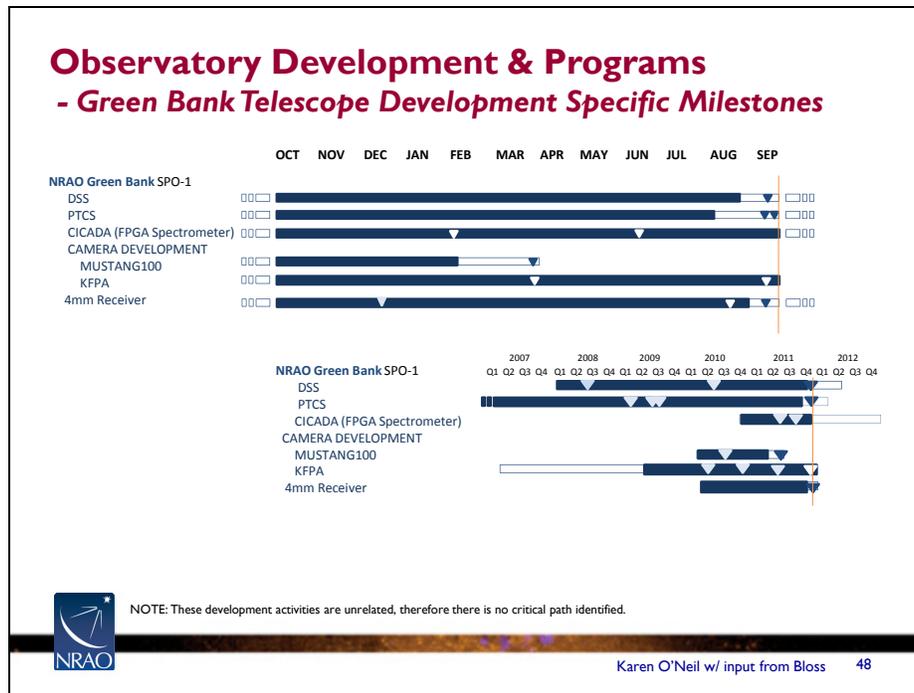
- **Green Bank Telescope (cont.)**
 - **4MM Rx:**
 - GBT tests begin with lower performance amplifiers
 - Reuse of optical table from earlier receiver design proves more complicated than estimated
 - **Dynamic Scheduling**
 - Enhancements continue but Q4 completion of project delayed one month by loss of key resources.
- **Other Projects**
 - Completed installation of a WV Dept. of Highways CORS GPS station

Karen O'Neil w/ input from Bloss 47

4mm Receiver: GBT tests of the new **4mm receiver** began in Q4 using LNAs and post amplifiers from other projects and Green Bank stock. The optical table mechanism which was repurposed from an earlier W-Band project continues to exhibit operations problems when the telescope is tipped (operating conditions new to this receiver), delaying final commissioning 3-4 weeks. Post-commissioning, the lack of CDL-provided Low Noise Amplifiers will likely result in further delays. **Risk:** Shared-risk observing and receiver release is delayed, optimal 2011/12 HF weather may be missed. **Mitigation:** Revisit criterion for re-use of older components and systems in new receivers (across projects). Commission receiver with existing LNAs and second stage amplifiers to minimize delay when new amps become available. Continue to press the ODP to raise the priority of the new CDL amps.

Dynamic Scheduling (DSS): The **Dynamic Scheduling** team lost 1.5 months of a lead programmer as he covered partial responsibilities for the Software Division Head vacancy in Q4 resulting in a delay of some Q4 closeout items into FY 2012. **Risk:** The project is extended one month, delaying the re-deployment of DSS programmers to FY2012 projects. **Mitigation:** None; the affected FY2012 projects (primarily telescope software improvements) may also be delayed by as much as one month or lower priority activities de-scoped.

Other Projects: The West Virginia Department of Highways and NRAO Green Bank completed installation of a Global Positioning Satellite fixed station for inclusion in the **CORS network**. The station will be used to measure variations to be included in corrections 3-D location determination. (<http://www.ngs.noaa.gov/CORS/>) WVDOH will provide descriptive materials about the network to the Green Bank Science Center.



DSS: Q4FY11 - Final release of the DSS with all observing efficiency and ease-of-use components is delayed one month due to lost resource. **Risk:** The project is extended one month, delaying the re-deployment of DSS programmers to FY2012 projects. **Mitigation:** None; the affected FY2012 projects (primarily telescope software improvements) may also be delayed by as much as one month or lower priority activities de-scoped.

PTCS: Q4FY11 - Laboratory tests of the new servo system is delayed due to underestimation of the complexity of the control kernel. Some hardware installation resources re-deployed to accomplish other non-PTCS higher priority activities during the delay. **Risk:** The final commissioning of the replacement servo will be delayed into Q2 FY2012 and the follow-on performance improvements also delayed. **Mitigation:** A second digital electronics supervisor has been added to the project to independently assess the scope and complexity of remaining kernel work. Only the testing phase remains and compressing or de-scoping is a risk believed much worse than the delay in completion.

CICADA (FPGA Spectrometer): Development remains on track for a Q1 FY2012 integration test with the GBT

Camera Development: MUSTANG100: Project suspended in Q2 FY2011; **KFA:** Project complete
4mm Receiver: Q4FY11 – Ongoing issues with optical table has delayed final commissioning. **Risk:** Shared-risk observing and receiver release is delayed, optimal 2011/12 HF weather will be missed. **Mitigation:** Continue modifications to optical table. Commission receiver with existing LNAs and second stage amplifiers to minimize delay when new amps become available.

Observatory Development & Programs - Coordinated Development Laboratory

- **Amplifier Production and Development**

- Delivered 26 new amplifiers to EVLA and 4 to VLBA.
- Delivered 12 P-band amplifiers to USNO/NRAO P-band receiver project
- Repaired and retested 13 amplifiers for the EVLA, GBT, and VLBA.
- Upgraded/repaired 4 26-36 GHz amplifiers for CARMA
- Development of ALMA bands #1 and #2 amplifiers using NGST cryo3 devices continues.
- Research into general noise properties of three terminal active devices and in particular on noise properties of heterojunction bipolar transistors (HBTs) and CMOS MOSFET continues.
- Research into noise properties of phased array feeds continues.
- RadioAstron was launched on July 18, 2011, carrying four 18-26 GHz low-noise amplifiers built by NRAO. These were delivered in 2004.



Amplifier Production: New amplifier production included twelve 230-470 MHz amplifiers, four 2-4 GHz, six 4-8 GHz, ten 8-12 GHz, and six 12-18 GHz. Repair, upgrade, and retesting of amplifiers included one 230-470 MHz, four 1-2 GHz, three 2-4 GHz, two 4-8 GHz, two 8-12 GHz, one 38-50 GHz amplifier, and four 26-36 GHz CARMA amplifiers. In total, 55 amplifiers were shipped. The EVLA and VLBA amplifier and production is approximately on schedule.

Amplifier Development: The work is continuing on understanding the performance of 30 micron wide cryo3 devices at W-band frequencies, following the development of a 75-120 GHz demonstration amplifier the previous quarter. Experimental evaluation of ALMA band #1 amplifier awaits the availability of technician time. RadioAstron was launched on July 18, 2011, carrying four 18-26 GHz low-noise amplifiers built by NRAO. These were delivered in 2004 and all four are working.

Observatory Development & Programs - Coordinated Development Laboratory

- **Electromagnetic Development**

- Presented a paper titled “A Compact Full Waveguide Band Turnstile Junction Orthomode Transducer” at the URSI General Assembly & Scientific Symposium in Istanbul, Turkey
- Studied the different feed options for an 800 MHz array feed receiver for the GBT
- Completed far-field pattern measurements on a prime focus feed (choke-ring feed) and a reference feed (corrugated horn) between 11-12 GHz.
- Measured five X-band phase shifters for the EVLA.



Electromagnetic Development: A small aperture (1.7λ) corrugated horn and a short-backfire antenna feed (SBA) were considered for the 800 MHz feed array receiver. Aperture efficiency and spillover were computed for both cases. A modified version of the SBA will be used because of space constraints. The 11-12 GHz feeds will be used for making holography measurements on the Sardinia Radio Telescope.

Observatory Development & Programs - Coordinated Development Laboratory

- **Advanced Receiver Development**
 - S-Band cryogenic DOMT test dewar refurbishment continues.
 - Analog-to-Digital-to-Photonic converter testing delayed.
 - Theoretical study of triple-ridged feedhorn concept in progress.
- **Millimeter & Submillimeter-Wave Receiver Development**
 - Completed wafer of SIS mixers for 385-500 GHz. Awaiting testing.
 - Started work on SIS junctions with AlN barriers and both electrodes NbTiN. This is a crucial step for next generation Band-10 and Band-11 receivers.
 - Design of balanced and sideband-separating SIS mixers continues for 780-950 GHz.
 - SOFIA-OPTIMUS proposal submitted to NASA: 6 pixel, 1.2-1.6 THz spectral-line receiver using waveguide HEB mixers.

S. Pan w/ input from Morgan and Kerr 51

Advanced Receiver Development: Work on the test dewar for the S-Band cryogenic DOMT continues. This includes new wiring harness for the heaters, temperature sensors, and bias supplies, as well as new control electronics, vacuum accessories, thermal transitions, and cold plates. Construction of a prototype Analog-to-Digital-Photonic converter was initiated during this quarter. This would be the first version of the Advanced Receiver concept on the warm side to include all necessary functions to go from an analog RF input to digital fiber-optic output in one integrated module. All parts were received; however, the printed circuit boards were incorrectly made, having twice the thickness specified. This prevents some of the critical components from fitting properly. A revised drawing of the housing has been made to accommodate the extra thickness and it is now under construction.

Anticipating successful testing of the triangular-waveguide S-Band OMT above, theoretical work continues on an ultra-wideband version based on triple-ridge waveguide. The science case for such wideband receivers with uncompromised noise performance is well known and compelling (e.g. NANOGrav). The triple-ridged OMT has been modeled successfully with excellent performance, as have the thermal gap and vacuum window, all new components which are critical to the high performance standard sought by this development program. The remaining critical development is a wideband feed that could efficiently couple to such a structure without excitation of undesired modes leading to poor cross-polar performance. Early simulated results are encouraging, but not as yet acceptable. A thorough study of the theoretical underpinnings and limits of such a structure is under way to guide this effort in the future. An in-house custom software algorithm is now being considered to facilitate this.

Observatory Development & Programs

- Coordinated Development Laboratory

- **Millimeter & Submillimeter-Wave Receiver Development cont.**
 - ALMA Development Proposals in preparation:
 - Band 11 Receiver Development
 - Band 6 Second-Generation Receiver Development
 - High-precision submillimeter waveguide flange for new IEEE standard undergoing further refinement and testing (with UVML and VDI).



S. Pan w/ input from Kerr 52

Millimeter & Submillimeter-Wave Receiver Development: The ability to manufacture SIS junctions is vital to the maintenance and continued development of ALMA and other sub-mm telescopes. The University of Virginia Microfabrication Laboratory (UVML) is the sole remaining U.S. facility with this capability. These NRAO projects are being done in collaboration with UVML, the University of Arizona, the Harvard-Smithsonian Astrophysical Observatory, the University of Virginia Electrical Engineering Department, and Virginia Diodes Inc. Following earlier contamination of the Inductively Coupled Plasma (ICP) source at the UVML, good quality SIS junctions with AlN barriers are again being produced. A wafer of 385-500 GHz SIS junctions has been completed and is now awaiting testing. This band is being used for testing new circuit concepts suitable for eventual use in Bands 10 and 11 (NRAO/UVML/UAZ). Work has begun on SIS junctions with AlN barriers and both electrodes NbTiN. Because of the higher energy gap of NbTiN, this is a crucial step for next generation Band-10 and Band-11 receivers. Design of balanced and sideband-separating mixers for ALMA Band 10 (780-950) continues, based largely on the 385-500 GHz prototypes (NRAO/UVML). To bring in outside funding, a proposal has been submitted to NASA in response to the call for proposals for SOFIA 2nd Generation Instrumentation. We are proposing OPTIMUS (Optimized Pixel array Terahertz Instrument and Multi-Use Spectrometer), a 6-pixel spectral line receiver for 1.2-1.6 THz using Hot Electron Bolometer mixers (NRAO/UVML/SAO).

In anticipation of the call for ALMA Development proposals, study proposals are being written for a Band-11 receiver and a second-generation Band-6 receiver (NRAO/UVML). The high precision submillimeter waveguide flange proposed as part of a new IEEE standard is undergoing further refinement to allow backward compatibility with most existing standards (NRAO/UVA/VDI).

Observatory Development & Programs - Coordinated Development Laboratory

- **Phased Array Feed**

- Completed cross-coupling and other receiver lab tests following run on 20-meter telescope.
- Began system modification to install L-band fiber modems in receiver box.
 - Increases number of channels from 19 to 38 (dual polarization)
 - Moves all frequency conversions to lab with data acquisition equipment
 - Continued installation of fibers from 20-meter, GBT, and outdoor test building to receiver/data acquisition location in lab
- Continued analysis of data from cryogenic receiver run on 20-meter.
- Began work on more sophisticated noise model for the array.
 - Improved understanding of most recent results
 - Guide to improved array diagnostics
- Evaluated progress on CASPER-based real-time beamformer.



Phased Array Feed (formerly called Beam Forming Array): Fiber modem system will provide more efficient system tests by eliminating the need to moved large data acquisition system from lab to telescope to outdoor test building and reducing thermal problems with operating equipment away from lab air conditioning. This change also improves network access to the system. BYU student work on FPGA beamformer proved considerably more difficult than expected. Professional experience with FPGA design is an essential prerequisite for efficient application of the CAPSER function library. Near-term goals for FPGA applications scaled back to wider bandwidth data acquisition with continued of software and possibly GPU correlator.

Observatory Development & Programs - Coordinated Development Laboratory

- **The Precision Array to Probe the Epoch of Reionization (PAPER)
(collaboration with UC Berkeley) (see NIO)**
 - South African 64-element array
 - Observations continue
 - Green Bank 32-element array
 - Observations continue
 - Engineering experiments continue
 - Study of ionospheric effects on PAPER data
 - NSF Grant received to expand South African Array to 128 elements
- **LUNAR**
 - Work continued on the NASA Dark Ages Radio Explorer (DARE) mission proposal, which is now in external review by NASA.
 - Work on the DARE Instrumentation Verification Plan continues.

S. Pan w/ input from Bradley 54

The Precision Array to Probe the Epoch of Reionization (PAPER): Components are being ordered for the expanded South African Array. Data analysis and observations continue with the existing arrays.

LUNAR: The Lunar University Node for Astrophysics Research (LUNAR) is a grant from the NASA Lunar Science Institute to develop instrumentation for lunar-based research. Our current activity is centered around the Explorer-class DARE mission proposal with specific attention given to the antenna and front-end design concepts.

Observatory Development & Programs

- *New Initiatives*

- **DVA-I**

- DVA-I Letter of Intent signed by Cornell, HIA and NRAO.
- Last minute objection to terms by University of Manchester necessitated amending the LOI. Done at end of Q4
- Ephraim Ford replaced C. Langley as Project Manager.
- Antenna design review/PDR to be held in early October 2011.

- **NANOGrav**

- Draft white paper on NANOGrav status and consortium plans will be discussed at November 17/18 workshop in Charlottesville.



NSF cancelled remaining \$2.3M of TDP award to Cornell in early October 2011. DVA-I Managing Board has endorsed a close-out plan aimed at delivery of antenna and mount design to the LOI partners by ca. February 2012; plan will be supported in part by carried over TDP funds. Update will follow in QSUI FY2012.

Observatory Development & Programs - *New Initiatives*

- **Space Very Long Baseline Interferometry**
 - RadioAstron successfully launched July 18, 2011
 - Spacecraft operating satisfactorily
 - First fringe tests scheduled early Q1 FY2012
 - No new developments in Lebedev Physical Institute exploration of plans to refurbish a GB antenna for RadioAstron ground station.
- **PAPER**
 - The \$4.5M PAPER proposal to NSF to expand to 128 elements and begin EOR observations was successful and will be fully funded.
 - Fiber connection from PAPER site in SA to the Internet complete
- **Export Control**
 - Review of export for SHAO C-band receiver nearly complete
 - Significant progress on developing an export control program for the Observatory.



New export control consultant (Donald Fischer) hired in Q4, has helped greatly in expediting and focusing export control issues for Observatory.

Observatory Development & Programs - New Initiatives

• VLBA – Status of External Operations Support

- SHAO
 - SHAO C-band receiver contract nearly complete
 - SHAO will contribute \$50k to export control assessment
 - SHAO contribution of \$50k for VLBA Ops (first payment) in process
- MPIfR awaiting word on request for \$200k per year support of VLBA
- All details of ASIAA offer to assume S&B of MK site technicians completed, awaiting final steps by ASIAA.
- Draft agreement with CASS/ICRAR for \$125k per year for at least 2 years completed and sent to CSIRO
- USNO
 - Problem with NSF IAT fees has been avoided this year and transfer of \$1M from USNO to NSF has begun
 - However, transfer cannot be completed until FY12 budget is approved – USNO CR funds prohibit use for new starts
 - NSF has directed that no UTI-UTC observations be made until funding is in hand
 - Expect contract for DiFX software correlator clone in FY12



SHAO = Shanghai Astronomical Observatory. Currently appears that there are no export impediments for C-band receiver.

DiFX = VLBA software correlator

Agenda

- Science Results
- Observatory Science Operations
- Observatory Telescope Operations
- Observatory Development & Programs (ODP)
 - Coordinated Development Laboratory
 - New Initiatives Office
- Boarder Impact
 - Education and Public Outreach
 - Diversity
- Observatory Administrative Services
- Director's Office



Broader Impact

- Education & Public Outreach

- **External Press/Media Activity**
 - Three national press releases issued (see notes) plus one local release in NM
 - Fielded numerous media queries regarding "EM-sensitive" refugees flocking to the National Radio Quiet Zone
 - Did web link to NASA release on black hole eating a star
 - Hosted NHK and BBC television crews in Green Bank
 - NRAO received mention in 164 articles in U.S. publications
 - NRAO received mention in 75 articles in international publications from 25 countries
- **Education Activity**
 - Conducted Chautauqua Short Course for College Teachers in Socorro – 15 attendees.
 - Several overnight educational events held in Green Bank, including conducting research with the 40-foot telescope
 - Held a number of longer educational events in Green Bank.



John Stoke 59

National press releases: (1) "Exotic Galaxy Reveals Tantalizing Tale" (<http://www.nrao.edu/pr/2011/spiralradio/>); (2) "Cryogenic Catering Truck Comes to the ALMA Observatory" (<http://www.nrao.edu/pr/2011/fesv/>); (3) "NRAO Astronomer, Wife Become US Citizens at VLA Ceremony" (<http://www.nrao.edu/pr/2011/citizens/>). Local press release in New Mexico was to announce appointment of Dale Frail as head of NM Operations. **Other NM-based education activities** included: (1) guest speaker for Technical Communication course at NM Tech; (2) NRAO-sponsored Enchanted Skies Star Party (Scott Ransom, keynote speaker); (3) Conducted VLA tour for University of Washington grad students; (4) conducted public tours of VLA on first Saturdays of July, August, and September, with attendance of 101, 59, and 104 persons respectively; (5) conducted VLA tour for Socorro High School; (6) conducted VLA tour for NM Tech orientation parents and students; (7) participated in a resurrected Radio Astronomy for Teachers course with the Masters of Science Teaching (MST) program at NM Tech - 4 NM High School Teachers participated July 11-15; (8) continued our partnership with NM Highlands University (a minority serving institution) and AmeriCorps, with two graphic arts interns living and working at NRAO designing posters, VLA merchandise graphics, flyers, and brochures. **GB overnight educational events participants:** National Youth Science Camp (delegates from 50 states plus Central and South American delegates); Frostburg State University Upward Bound Math and Science Program (MD); West Virginia Episcopal Diocese Conference; Mt Vista Governor's School (VA); NOVAC Almost Heaven Star Party- Tour and overnight to use the 40 Foot (DC area); Roanoke Catholic School (VA). **GB longer educational events:** Green Bank Star Quest Annual Multi-day Star Party with keynote speaker Seth Shostak; Pulsar Search Collaboratory Teacher and Students Leader Institutes -- 36 teachers and 64 K-12 students from NC, NM, NJ, IL, MD, VA, PA, WV, WI. 4 Teacher mentors 2 graduate students and 6 undergraduate students also participated; WV Governor's School for Math and Science (60 rising high school freshmen from WV).

Broader Impact

- Education & Public Outreach (continued)

- **Internet Media Activity & Media Production**

- NRAO Twitter followers now exceed 1,500; (20% growth from Q3)
- Facebook fans have topped 4,000; (10%+ growth from Q3)
- Conducted filming in GB for creation of a “Green Bank Explorer” virtual tour akin to the existing ALMA Explorer.
- Extensive efforts underway to support the coming announcement of ALMA Early Science
- ALMA documentary rough cut video and script sent to our potential sponsor PBS station for review and comments. Space animator contracted to produce animations for the program. NRAO EPO graphic artists are busy producing several motion graphics for the program



Broader Impact

- Diversity

- Green Bank and Socorro Employee Diversity Group Meetings conducted.
- Training for EDGs at Green Bank – Scheduled for October 2011
- Debriefing meeting with Drs. Marcus Alfred and James Lindsey to discuss Howard University Summer Internship Program – Program to continue
- Coordinating NRAO Scientific Staff to provide lecture and colloquia visits with Howard University - scheduled for November 2011
- Attended Black and Hispanic National Society of Physicists
- Developed diversity funding proposals and secured funding for FY 2012 Broader Impact and Diversity initiatives:
 - AUI commitment \$20,000
 - NRAO commitment \$22,000
- Dale Frail presented donation to Socorro City Council for Summer Student Youth Employment Program

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AUI will fund Building Bridges to Africa Project (\$12,000), Howard University Engineering Internship (\$5,000) and the cost associated with NRAO staff traveling to Howard to present lectures/colloquia and build the Astronomy curriculum (\$3,000).

NRAO Director's fund will fund African American Teaching Fellows (\$10,000), Boys & Girls Club of Central VA (\$7,000), and Socorro Summer Youth Employment Program (\$5,000).

The Socorro Summer Student Employment programs provide high school students to gain "real work" experience. The city of Socorro placed 8 students at the SOC site during the summer of 2011 with all cost paid by the city. The NRAO's matching donation will allow us to double the number of participants for the summer of 2012 (four of the students were minorities).

Agenda

- Science Results
- Observatory Science Operations
- Observatory Telescope Operations
- Observatory Development & Programs
- Broader Impact
- Observatory Administrative Services
 - Observatory Business Services
 - Fiscal
 - Contracts and Procurement
 - Management Information Systems
 - Environmental Safety and Security
 - Human Resources
 - Computing and Information Systems
 - Office of Chile Affairs
- Director's Office



Observatory Administrative Services

- Observatory Business Services

- **Observatory Business Services**

- Install electronic passkey doors at CIS server area, communications room, and OBS/Human Resources hallway to meet HIPPA and other security requirements [Q3]. Have found available vendors and in process of obtaining quotes. Selection and installation will be made in FY12 Q1.
- Replace Edgemont Road phone and voicemail system [Q4] Quotes are being obtained. Will implement during FY 2012 Q1.
- Complete installation of cell phone booster [Q4] Have incorporated cell phone boosters into phone and voicemail quote. If pricing is acceptable will implement during Q1 FY 2012.



Observatory Administrative Services
- Observatory Business Services

- **Contracts & Procurement**
 - Implement P-Card Program [Q3]. Will not make Q3 deadline. Fiscal has taken implementation lead. **The procurement card program is on hold until all reviews and audits are done.** Updated completion date is end of Q4 FY 2012
 - Complete commitment of ARRA funds [Q3]. Delayed into Q4 due to resolution of Davis-Bacon Act issues.
 - The CAP Manual Rev I Updated completion date is end of Q2 FY 2012
 - Export Compliance Procedure- Start Q4 FY 2011 completion will be Q4 FY 2012



John Cappiello 64

Note: Resignation of Contracts & Procurement Manager has slowed advancement of projects however progress is being made through load sharing with Fiscal and Business Services.

Implement P-Card Program [Q3]. Contract with US Bank has been signed and implementation team is working with Bank on procedures and data. Full details of phased roll-out and procedures manual are in-work. The procurement card program is on hold until all reviews and audits are done

Complete commitment of ARRA funds [Q3]. Two of the ARRA tasks remain open while determining if they have satisfied Davis-Bacon act provisions. Awaiting determination of path forward for both contracts that are already closed out. Once a determination has been made in consultation with NSF, funds will be distributed, as necessary, to meet the provisions of the act. Also need to rebalance cost allocations of two projects that have overrun their budgets. This will be accomplished once path forward for Davis-Bacon issues are resolved.

Implement Export Compliance Procedures [Q4]. Fisher Associates have been retained to help develop an Export Compliance program.

Observatory Administrative Services - Observatory Business Services

- **Contracts & Procurement (cont.)**
- Grants and Contract Administered

Name of Grant	Funding Institution	Grant Value	PI	Period of Performance	
Probing the Early Evolution of galaxies and Massive Black Hole	SAO	\$96,400	Amy Reines	08/01/11	07/31/13
NAIC/NRAO Sixth School on Single Dish Radio Astronomy	NSF	\$21,183	Karen O'Neil	06/15/11	05/31/12
Searching for More radio Milliseconds Pulsars in Fermi Unassoc	NASA	\$79,103	Scott Ransom	08/25/11	08/24/12
Diffuse ISM Phases in the Inner Galaxy	JPL	\$5,534	Harvey Liszt	07/25/11	12/31/13
A definitive Herschel Study of the Most Powerful Local Radio g	JPL	\$18,597	Chris Carill	07/26/11	12/31/13
The Formation and Structure of Proto-Planetary Disks Around the Youngest Protostars	STSCI	\$107,765	John Tobin	09/14/11	08/31/14



Observatory Administrative Services

- Observatory Business Services

- **Fiscal**
 - Coordination and administration of the financial reporting close for fiscal year 2011.
 - Coordination and assignment of responsibilities in preparation for the annual OMB A-133 and financial statement audit.
 - Preparation of requested Incurred Cost Submissions for Fiscal years 2008, 2009, 2010.
 - Completion of the “Review of Executive Compensation and Accounting System” conducted by the DCAA, as requested by the Office of Inspector general (OIG).

Connie Williams 66

The annual OMB A-133 and Financial Audit is conducted on an annual basis. The audit begins the week of October 24, 2011 and continues through issuance of the final audit report in February 2012.

On June 28, 2011 AUI received a request from NSF on behalf of the OIG to submit Incurred Cost Proposals for FY 2008, 2009, and 2010. The initial proposals were submitted on September 6, 2011 and a request was received by the DCAA on October, 13 2011 to submit additional schedules. Upon completion of the additional schedules- and audit of the submissions is to be scheduled by the DCAA.

The purpose of the scheduled Internal Audit is to review the business functions of the OCA specific to the areas of contracts administration, local staff payroll, accounts receivable, travel reimbursements and unallowable costs.

The NRAO Procurement Card Program will replace the current Departmental Credit Card Program and will allow for electronic monthly statement reconciliation and approval. The initial planning phase was concluded in FY 11 Q2 and full implementation is targeted for Q1 of FY 12.

The Fiscal Division has completed the preliminary planning to transition vendor payments to electronic ACH remittance and will complete transition for a select group in FY 11 Q4 with full implementation, for all vendors, scheduled for Q2 FY 12.

Observatory Administrative Services
- Observatory Business Services

- **Management and Information Systems**
 - Update JD Edwards ERP software from 8.1 to 9.x [Q1, Q2, Q3, Q4]
 - Setup and testing of Employee Open Enrollment process
 - Setup for NRAO Financial End of Year Processing



Chuck Beverage 67

Update to JDE ERP software will continue until full implementation – Projected to be February 2011.

Setup of End of year processing – Work Breakdown Structure Changes and year end prep happens before Oct 1 so that year end will be a timely process. WBS changes are ready to go and accounts are ‘turned on’ upon end of year close completion.

Observatory Administrative Services

- Observatory Business Services

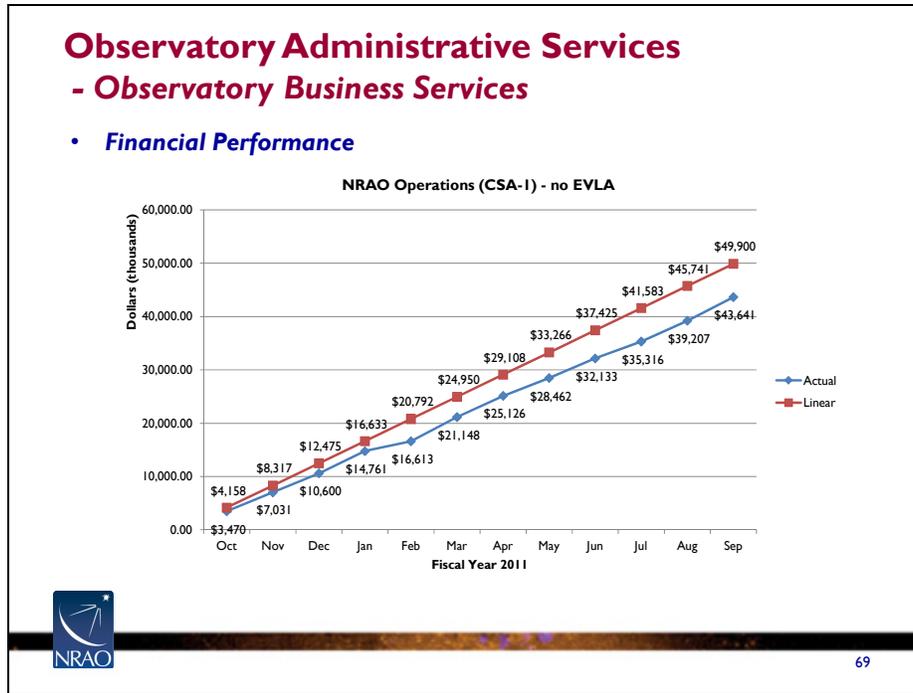
- **Environmental Safety and Security**
 - Create an OSHA 10-hour compliant course for NM to be delivered by ES&S personnel [Q1] Course is in review, will finalize end of FY 2011.
 - Crisis Management Plan in final draft review. On schedule to complete in Q4.

Bob Daniels 68

Socorro Facilities (VLA/DSOC): NM has replaced a higher cost Safety Officer role with a more effective, lower cost field based Safety Technician. Twenty six sections of the New Mexico appendix to the Corporate Safety Manual have been brought current. NM Management has rededicated itself to creating a better and more safe facility with monthly “walk about” inspections and routine training meetings in Socorro & the VLA. ASIAA Safety is being supported as an incremental task. All training, inspection and special regulatory programs (OSHA, EPA, PSTB, etc.) have been completed as required. The DSOC building fire alarm system/Panel was replaced.

Green Bank Facilities: No major ES&S (EPA, OSHA, security, etc) incidents at Green Bank this quarter. Within limits performance of site sewer water treatment system continues for the third successive year. Green Bank injury frequency and severity continues below the Observatory’s operating units average in frequency & severity. All regulatory training is current. Recycled 50 gallons of used oil. Four hundred pounds of cardboard were taken off site for recycling. Forty pounds of small cell batteries were sent off for recycling.

Charlottesville Facilities: No injuries/incidents during the quarter. Training is complete. Drills conducted. Earthquake response critiqued and modified as a result of the VA earthquake centered in Mineral (~25 Miles E. of CV). Hazmat support and backup continues to ALMA FEIC and NTC facilities; had the Backend FM 200 Safe Gas Fire Suppression system serviced on schedule.



FY 2011 budget based on President’s Request and without consideration for the continuing resolution:

NRAO Operations (less EVLA) FY 2011 new funding allocation is \$43,176.8k. Total available funding including prior year commitments and carryover totals \$49,963.5k. Total expenses and commitments for the first three quarters of FY 2011 is \$32,332k or 64.7% of total available funds.

Observatory Support Services
- Human Resources

- **Human Resources**
 - **Retiree Medical Plan Redesign**
 - **Benefits Benchmark Survey**
 - **Retirement Plans – Legislative Changes**
 - **Staff Promotions and Equity**
 - **Merit Review**
 - **Hired Sr. HR Generalist for Green Bank**
 - **ALMA Human Resources Advisory Group**



Jim Firmani w/input from Giles/Franks 70

Major changes are being made to the AUI **Retiree Medical Plan** to reduce the plan's FAS 106 liability and plan expenses. Changes include freezing the current plan to new hires; establish grandfather rules for the current plan for existing employees based on age and years of service; increase eligibility rules to age 60 and 10 years of service equaling 70 or above; charge premiums for new over age 65 retirees; and establish a Health Savings Account/High Deductible Health Plan for employees not eligible for the current retiree medical plan. NRAO worked with Mercer Consulting to establish a list of **benchmark** organizations for its benefits plans. Mercer completed a benchmark study of AUI/NRAO benefits against these organizations that qualified and quantified the above-benchmark of the AUI Retiree Medical Plan and at/near benchmark status of all other NRAO covered benefits. New employer **retirement plan** sponsor disclosure notice requirements will be in effect in 2012 that establish uniform, basic disclosures regarding available retirement plans and investment options to allow eligible employees, participants and beneficiaries to make informed investment decisions. HR is working with TIAA-CREF and Fidelity to update the fund structures to meet the new requirements before the 2012 mid-year effective date. On July 7, 2011, NRAO Human Resources initiated a process that provided NRAO ADs with the opportunity to recommend **promotions and equity adjustments** for their staff. They were informed that the funding would come from the salary increase budget allocated to their respective site and a careful evaluation of each recommendation would take place by HR and the Directors Office. A small group of employees already identified by HR as earning substantially less than market would be included in this process. This process was completed in early September and resulted in pay increases for 62 non-management level employees totaling \$206,104. The pay increases were made effective in the August - September pay cycle. Modest salary increase pools (1.55% to 1.78%) were developed after subtracting the \$206,104 in staff promotions and **equity increase** from the 2% budget for all salary increases this fall. Each site AD is overseeing the distribution of their respective pool based on individual employee performance. This will be accomplished using salary increase guidelines (matrix) developed by HR to assist in determining employee increases based on performance and position in the range (Job Grade). The matrix is designed to reward and retain top performers who are making significant contributions to NRAO's success. To provide the Green Bank site with support for employment,

employee relations, diversity and general HR matters, a **senior generalist position was opened and filled** by a local HR professional. The NRAO Charlottesville Office hosted executives and managers from ESO, NAOJ and JAO for various meetings in September. The ALMA **Human Resources Advisory Committee** meeting was supported by NRAO HR.

Diversity Employment Results

- **Diversity New Hires**
 - **GB**
 - 3 Females
 - 2 Post Docs, 1 Science Ctr Supervisor
 - **SOC**
 - 1 Hispanic Male - Track Operator
 - 1 Asian Female - Assistant Scientist
 - **CV**
 - None



Diversity Promotions

- SOC
 - 1 Hispanic Female
 - 3 Hispanic Males
 - 2 White Females

- GB
 - 1 White Female

- CV
 - 2 White Females



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SOC:

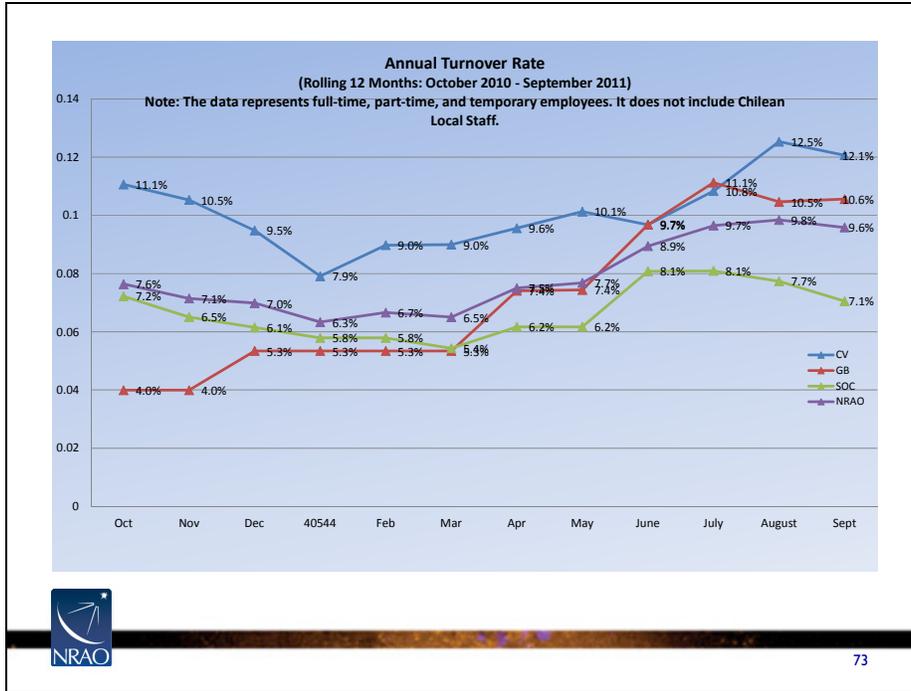
Constance Gallegos
Barbara Harris
Raul Lower
Linda Major
Steve Tenorio
Dominic Zamora

GB:

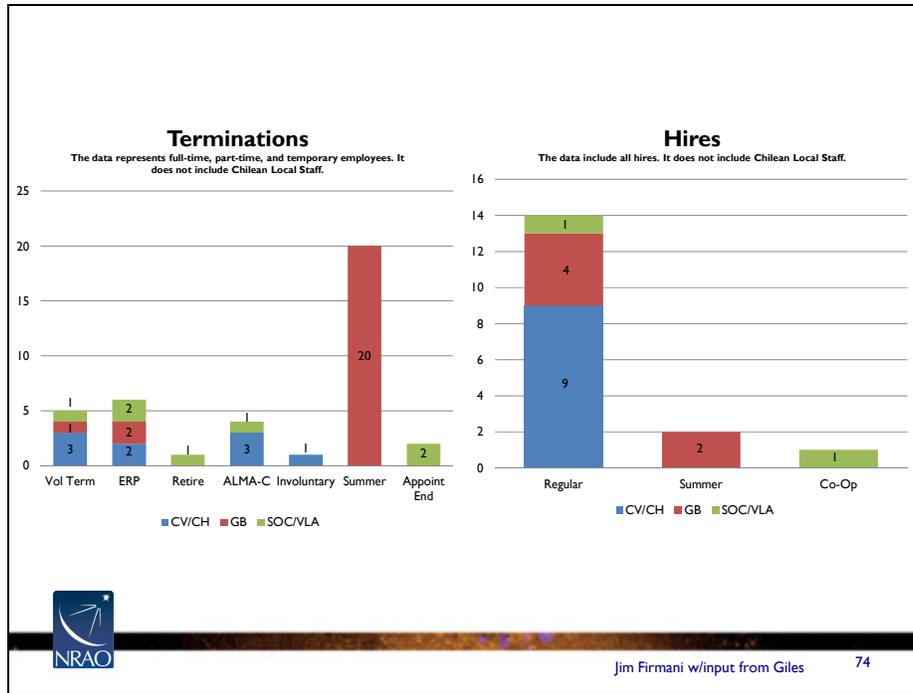
Sue Shears

CV:

Amy McReynolds
Denise Merricks
Lyndele Von Schill



See Next Slide for information.



Charts provide a breakdown of terminations and hires for the 4th quarter.

Terminations – The rate of voluntary terminations for the quarter was normal. Six out of 20 ERP volunteers retired during this period along with the second group of ALMA construction roll offs. Of the 4 ALMA-C roll offs, 1 found a new job and 3 went back to school. The Green Bank summer workers completed their work as scheduled.

Hires – Of the 9 regular hires, 5 are Scientific Staff, 2 are administrative staff, and 2 are support staff. Scientific Staff hires: 1 Jansky, 2 Post Docs, 1 Assistant Scientist, and 1 Research Associate.

Observatory Administrative Services

- Computing & Information Systems

- **Common Computing Environments (CCE)**
 - NRAO user discussion forum configured: science.nrao.edu/forums
 - Initial 8 compute and 2 storage systems in production for ALMA data analysis
 - Successful initial sync of ALMA data to NAASC and release of SV data
 - ALMA-Wide helpdesk expanded to cover Proposal Change Requests
 - Network performance to DSOC improved to allow EVLA replication to CV
 - GB observer support added to NRAO Helpdesk
 - 95TeraBytes of GBT survey data replicated to XSEDE storage
 - NSF/MPS Data Management and Sharing response aligned with OSO
- **Networking and Telecommunications**
 - Network systems for GB 10Gbit/s link finalized and ordered
 - CV Phone system and HD video con upgrade purchase executed
 - Network tunnel to JAO now in production verified at needed ~1TByte/Day
- **Security**
 - No production impacting security incidents occurred this quarter



David Halstead 75

NRAO hosted Science Forum installed (User Committee request using my.nrao accounts for posts). Parallel **computing** infrastructure (96 CPU cores and 50 TeraByte parallel file system) was brought into operations in the NAASC to support early science (Replica of the design in Chile). A full replica of all ALMA archived data stored in Santiago to date was replicated to the NAASC in preparation for Early Science. Throughput limitations in the National Lambda Rail backbone network were identified and mitigated ~500TeraBytes total will be copied to CV Q1 to provide a full diverse site replica of EVLA archive. Green Bank Observer supporting departments added to NRAO helpdesk to improve support. The NRAO hosted ALMA-global helpdesk was expanded to support an observer generated proposal issue escalation path. “Data Management & Sharing in FY11-16 timeframe” response sent to NSF/MPS and aligned with OSO DM coordination. First phase of replication of ~250TeraBytes of 350MHz pulsar search data was replicated to CV and then to NCSA archive resources on the national XSEDE infrastructure. Continued progress towards installation the 10Gigabit/sec network link from Green Bank site. Funding from BTOP stimulus and WV State coordination with Q3 FY12 completion for fiber build. Replacement of the end-of-life Nortel PBX **phone system** slated for Q1 FY12 (VoIP system purchased). Three HD video-con units and a replacement for the end-of-life video management system were purchased in Q4 with installation slated for Q1 FY12. The **high bandwidth** shared link from SCO to NAASC was provisioned and tested at bandwidth sufficient for Cycle 1 observations (100Mbps giving ~1TeraByte/day). **Physical access** to HR space and CV server room to be addressed by swipe cards (HIPAA audit). No production impacting security incidents occurred this quarter.

Observatory Telescope Operations

- Office of Chilean Affairs (OCA) Significant Events

- **Staffing**
 - International staff supported by the OCA: 25
 - ALMA local staff
 - 14 new hires, for a total of 265 LSM (26 AUI/NRAO staff)
 - Coordination with new ALMA HR management
 - Second update of Internal Rules and Regulations Manual approved by the ALMA HR Advisory Group
 - Implementation expected in Q1 FY2012
 - Implementation of new automatic time & attendance system awarded to vendor
 - The external payroll provider company (TMF) was replaced by a new vendor (Payroll Ltda.)
- **Activities**
 - Purchase Orders processed:
 - 56 (\$439k) for ALMA Construction
 - 221 (\$1,239k) for JAO Operations


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The number of **international staff** increased with the arrival of Michael Thorburn (Head of ALMA Department of Engineering), Gary Parks (JAO Project Manager) and Violette Impellizzeri (JAO Astronomer). OCA has increased the total number of **Local Staff Members** contracts in the quarter, bringing the total number of employees for which OCA provides ALMA with legal, payroll and travel support to 265 local staff (26 under AUI/NRAO's). A second revision to the **Internal Rules & Regulations Manual** was approved by the HRAG. An automatic time & attendance system was awarded to a vendor and implementation is expected in Q1 FY2012. The **external payroll provider** company (TMF) was replaced by a new vendor (Payroll Ltda.) in order to implement a more effective software platform that includes an HR database, as well as improve the level of service.

OCA has provided the legal and institutional support for contracts and procurements for ALMA as follows: a total of 56 purchase orders were issued for ALMA Construction (439 k\$) and 221 for ALMA Operations (1,239 k\$). The activities for ALMA Construction involve those described in the Site IPT section, namely AOS Roads Construction Contract, AOS Utilities – Electrical and FO cables installation contract, Fiber Optic Cable supply and Contractors' Camp expansion (JAO activity). The termination of the AOS Utilities – Electrical and FO cables installation contract with Echeverría & Kelly Ltda. continued to involve additional litigation in September. Also, the renewal negotiations of the Sodexo (catering, cleaning & hostelry services) contract was finalized and submittal to NSF is expected in October 2011. Monthly reports were issued to CONAMA (environmental authority) related to flora/fauna and archaeological follow-ups.

Agenda

- Science Results
- Observatory Science Operations
- Observatory Telescope Operations
- Observatory Development & Programs
- Observatory Administrative Services
- Director's Office
 - Office of Science and Academic Affairs (OSAA)
 - Communications
 - Spectrum Management



Observatory Science & Academic Affairs (OSAA)

- **General Activities**
 - Extensive work was done on the science sections of the LRP and POP, as well as the QSU.
 - NRAO science vision document being considered with Rick Fisher.
 - Reorganized and rationalized the Adjunct appointments at NRAO.
 - Biweekly and monthly meetings with HR initiated.
- **Recruiting**
 - Astronomer track search was concluded and one offer made to a female Astronomer, and accepted as a joint appointment with ASIAA.
 - Reviewed numerous ALMA-Chile scientist applications and offers, and established a procedure with HR.
- **Postdoc programs**
 - A mentoring memo was written outlining the numerous postdoc mentoring tasks and procedures across NRAO.
 - Jansky fellows submitted their semester reports to Jansky Program Coordinator.
 - Jansky fellows held their semester teleconference which included a scientific presentation and discussion of general postdoc issues.
 - Adverts went out for the 2012 Jansky Fellowship Program and the Jansky selection committee was established.
 - Funding was identified for 2 postdoc positions on the EVLA project, and advertisement was distributed.

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NRAO science vision document being considered with Rick Fisher.

Reorganized and rationalized the Adjunct appointments at NRAO.

Recruitment: Tzu-Ching Chang offered a split appointment (half-time with ASIAA) for **Tenure Track** Astronomer. Other future strong candidates were identified. Reviewed numerous ALMA-Chile scientist applications and offers, and established a procedure with HR. Reorganized and rationalized the Adjunct appointments at NRAO. Reviewed numerous ALMA-Chile scientist applications and offers, and established a procedure with HR.

Postdoc Programs: A mentoring memo was written outlining the numerous postdoc mentoring tasks and procedures across NRAO (with Schnee, ALMA postdoc mentor). Jansky fellows submitted their quarterly reports, reviewed by Goss (head of the Jy program). Individual interviews were held, as needed. Adverts went out for the Jansky fellows, and the Jansky selection committee was established. The budget could allow for 4 or 5 hires this year, taking into consideration some early departures, but this is contingent on budget. Jansky fellows held their triennial video conference, with science reports and discussion of general postdoc issues. Funding was identified for 2 postdoc positions on the EVLA project, and advertisement was distributed.

Observatory Science & Academic Affairs (OSAA)

- **NAASC Postdoc Activities**
 - Contributed to ALMA Cycle 0 documents and science verification guides
 - Contributed to Splatologue database
 - Contributed to ALMA calibrator database
 - Lead weekly lunch talk series and journal club discussion group
 - Attended conferences, wrote papers, conducted observations
- **NAASC Postdoc Mentoring and Training**
 - Interferometry Discussion Group
 - Python programming training
 - “Train the Trainer” by Crystal Brogan on how to reduce ALMA data
 - Journal club
 - Participated in PEP reviews with their functional mentors
 - Various science topic specific group meetings



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Postdoc Activities contributed to the operation of the NAASC, proofreading the Cycle 0 documents for ALMA observations and Science Verification CASA guides.

Postdoc Mentoring and Training was advanced by holding weekly discussion sessions on how interferometry works in practice, teaching an introductory Python class. NAASC postdocs participated in a mandatory training session on how to reduce ALMA data in CASA to support face-to-face visits. Postdocs lead the daily journal club and to attend the various weekly meetings of the research groups at NRAO and UVa.

Observatory Science & Academic Affairs (OSAA)

- **Jansky lecture**
 - Arranged by OSAA; given at all three sites by S. Weinreb.
 - 180 people attended the first Lecture given on September 20 in CV.
- **Scientific Staff**
 - **Scientific Performance Evaluation**
 - Continued science evaluation due to late-submission of PEPs.
 - **Academic promotions**
 - The tenure committee (APRC) met and made a final recommendation to the Director for a Tenure appointment.
 - Initial consideration have been made on academic promotions in SPRC-RE and SPRC-CS between the OSAA, the Director, and the committee chairs.
 - The Astronomy committee chair has been informed of the status of active promotion considerations.
- **Budget:**
 - Final FY12 budget has been submitted as well as close-out of FY11.
 - OSAA has also been considering the 5%, 10%, 20% scenarios.

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Jansky lecture: arranged by OSAA; given at all sites by S. Weinreb. Well attended in Charlottesville. Title: Radio Astronomy from Jansky to the Future, an Engineer's point of view.

Tenure committee was very active, and received review material for the candidate (Committee Chair: Goss). The committee met, and made a final recommendation, and a report was sent to the Director. The scientist promotions committees have been organized. Initial consideration has been made on Continuing Appointments in SPRC-RE and SPRC-CS between the OSAA, the Director, and the committee chairs (Pan, Fomalont, respectively). The Astronomy committee chair has been informed of the status of active promotion considerations (Condon). The committees will meet in Oct or Nov for the standard annual progress reviews.

Scientist Performance evaluation: continued science evaluation for late-submission of PEPs.

OSAA Head general activities: Submitted enews article for Mark Adams on high z CO with the EVLA. Presented lectures at LANL Cosmology Summer School. Working on low frequency imaging for cosmic reionization studies using the PAPER array. Working on cosmological deep fields in molecular gas. Successful EVLA, ALMA, and HST proposals. Observed extensively with EVLA, and helped numerous users with their spectral line observing. Attended meeting on CO intensity mapping in Berkeley.

Director's Office

- Communications

- **External & Internal Stakeholder Communications**
 - FY 2010 Annual Report mailed to additional high-profile international institutions and scientists; initiated work on FY 2011 Annual Report
 - Plone content management system implemented and integrated into the NRAO internal web site redesign
- **Science Community Communications**
 - Organized NRAO presence for January 2012 AAS meeting (Austin)
 - Exhibition, NRAO Town Hall, ALMA Special Session, “One Observatory” Splinter Session, Undergraduate Orientation, support materials
 - Both science symposium proposals submitted to the AAAS 2012 Annual Meeting (Vancouver) were peer-reviewed and accepted
 - Organized NRAO exhibition for the SC11 conference
 - Assisted with writing/editing Long Range Plan and Program Operating Plan
 - Initiated planning for the NRAO exhibition at 2012 IAU General Assembly


Mark Adams 81

FY 2010 Annual Report: An additional 200 copies of the Annual Report were distributed to international astronomical institutions, observatories, funding agencies, and key individuals. The on-line version is available via a flash application and as a pdf download. **Winter American Astronomical Society (AAS) meeting [9-13 January 2012, Austin]:** See the Events links at science.nrao.edu for additional info on each of these sessions. The “One Observatory” Splinter Session is titled “Proposing for Time on NRAO Telescopes”. **American Association for the Advancement of Science (AAAS) Annual Meeting [16-21 Feb 2012, Vancouver]:** The AAAS Annual meeting is the largest science meeting in North America and an excellent opportunity to attract major media attention for NRAO. The accepted science symposium proposals feature pulsar science, including strong gravity, nuclear physics, and NANOGrav [speakers Scott Ransom (NRAO), Ingrid Stairs (UBC), Ben Stappers (Manchester)]; and EVLA/ALMA Early Science highlights from relatively nearby star and planet-forming regions in our Galaxy to high-z [speakers Christine Wilson (McMaster), Dave Wilner (CfA), and Kartik Sheth (NRAO)]. **SC11 conference [13-17 Nov 2011, Seattle]:** Organized the NRAO exhibition at the International Conference for High Performance Computing, Networking, and Storage & Analysis (SC11). The conference will be held at the Washington State Convention Center, the same facility used by the AAS. Approximately 11,000 scientists, engineers, software developers, CIOs, and IT administrators from universities, industry, and government agencies attended. **IAU XXVIIIth General Assembly:** Beijing, China. 20-31 August 2012.

Director's Office

- Spectrum Management

- **General Spectrum Management**
 - Submitted FCC comments regarding proposed new rules for operation of 76-77 GHz vehicular and other ground radars
 - Attended WP7B and WP7D sessions at ITU-R in Geneva
 - Coordinated with JPL about restart of the 94.05 GHz Cloudsat orbiting radar
 - Met with SUBTEL in Santiago to discuss ALMA Radio Quiet Zone coordination
 - Co-authored review panel report for Australian and South African SKA bids regarding site protection through spectrum regulation

Harvey Liszt 82

FCC/Car Radar: RFI tests of 77-81 GHz car radars (other radars) currently underway at the ARO KPI2m

Geneva: Preparing for WRC12 in Jan-Feb 2012, drafting IUCAF White Paper summarizing RA positions.

Cloudsat: Satellite restart after incident in 04/2011 with a different orbit and much wider (6°) cone of avoidance.

SUBTEL: The Chilean telecom authority. They voiced unhappiness over ALMA attitudes, I am waiting for Lewis Ball to meet with me to discuss ALMA's continued refusal to engage with spectrum management.

SKA Panel issued its final report discussing pros and cons of the two bids.