

# Quarterly Status Update (QSU) #4 FY 2012 July - September 2012



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



## Quarterly Status Update Report Structure

- **Organized around these Observatory-wide functions:**
  - Observatory Science Operations (OSO)
  - Observatory Telescope Operations (OTO)
  - Observatory Development Programs (ODP)
  - Observatory Administrative Services (OAS)
  - Director's Office (DO)



Operating as 'One Observatory' spanning multiple sites, NRAO fulfills its vision and mission by organizing around four Observatory-wide functions: Science Operations, Telescope Operations, Development Programs, and Administrative Services.

For the past two years NRAO has been reviewing its organization structure, seeking to optimize Observatory-wide function and produce scientific and technical efficiency in NRAO operations. Initial efforts created new structures, including OSO (Observatory Science Operations), OTO (Observatory Telescope Operations), ODP (Observatory Development Program) and other functional groups. Implementation of these structures exposed the need to further define the structure and make some additional changes. However, the basic functional groupings continue to provide a logical construct for describing the scope of work at NRAO.

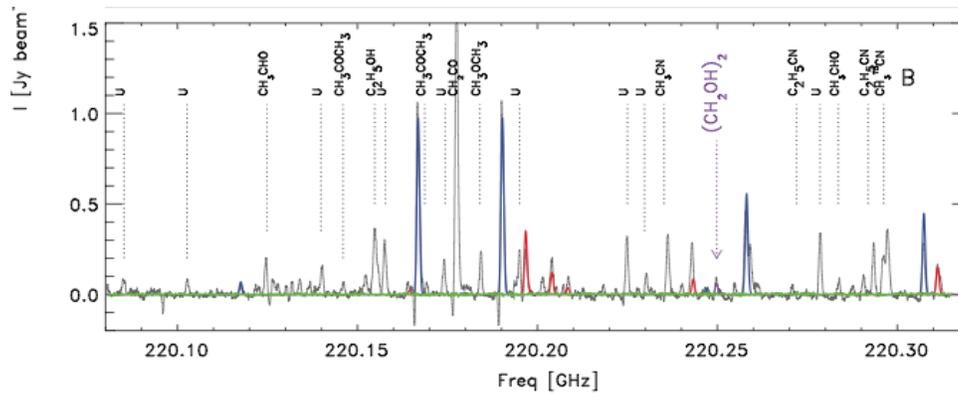
# Agenda

- Science Results
- Observatory Science Operations (OSO)
- Observatory Telescope Operations (OTO)
- Observatory Development & Programs (ODP)
- Broader Impact
- Observatory Administrative Services (OAS)
- Director's Office



## ALMA: Sugars around a proto-star

- Joergensen et al. 2012 detect 13 transitions of glycolaldehyde, the simplest sugar, in the class 0 protostar, IRAS16293-2422
- IRAS 16293-2422 is early-phase, solar-type binary
- Detecting sugars is key milestone in the path toward understanding the full chemistry leading to biological molecules



Spectrum of IRAS 16293-2422 with ALMA showing multiple lines from glycolaldehyde.

C. Carilli w/ input from Wootten

Title: Detection of the Simplest Sugar, Glycolaldehyde, in a Solar-type Protostar with ALMA

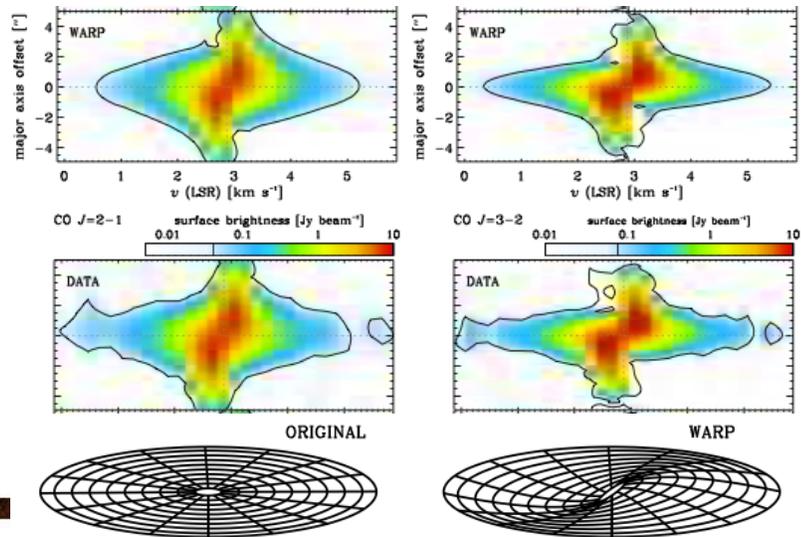
Web link: <http://adsabs.harvard.edu/abs/2012ApJ...757L...4J>

Publication: Joergensen et al. 2012ApJ...757L...4J

## ALMA: Imaging gas in a proto-planetary disk

- Rosenfeld et al. 2012 image the CO in TW Hya archtypal protoplanetary disk with information down to scales of 2AU
- The data are reasonably modeled by a warped disk on AU scales. Such a warp could be generated by an embedded massive planet in the disk.

CO observations  
and modeling of the  
warped disk in the  
protoplanetary disk  
TW Hya



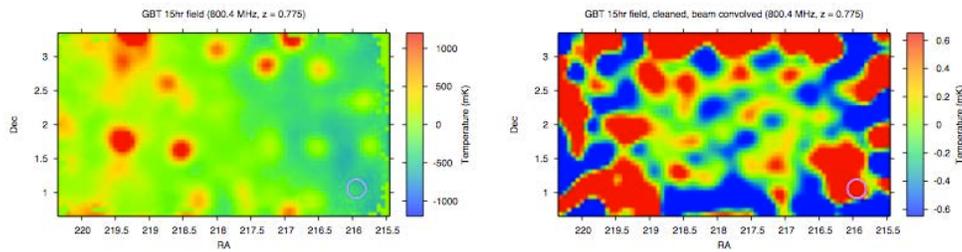
Title: Kinematics of the CO Gas in the Inner Regions of the TW Hya Disk

Web link: <http://adsabs.harvard.edu/abs/2012ApJ...757..129R>

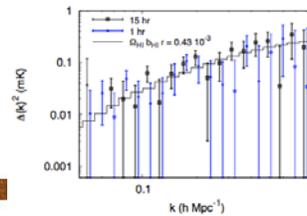
Publication: Rosenfeld et al. 2012, ApJ, 757, 129

## GBT: HI intensity mapping

- Masui et al. present GBT HI intensity mapping in the range:  $0.6 < z < 1$ , over two fields totaling  $\sim 41$  deg. sq. in the WiggleZ Dark Energy Survey area. These images represent the integrated HI surface brightness of thousands of galaxies over large cosmic volumes.
- The cross-correlation with the smoothed optical spectroscopic data shows a clear correlation, indicating HI signal on deg-scales. The HI intensity is consistent with optical quasar absorption line measurements for the evolution of the cosmic HI mass density.



GBT imaging of large scale regions in the WiggleZ field. Upper left is total intensity at 15' resolution, while upper right is with the continuum subtracted. Right is the cross powerspectrum with the optical redshift survey.



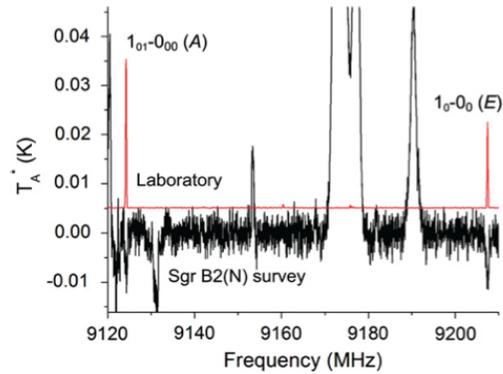
Title: Measurement of 21 Cm Brightness Fluctuations At  $Z \sim 0.8$  in Cross-Correlation

Web link: <http://arxiv.org/abs/1208.0331>

Publication: Masui et al. (2012) ApJL, in press, arxiv:1208.0331

## GBT + Lab astrochemistry find a new molecule

- A comparison of lab spectra from the UVa astrochemistry group with the GBT PRIMOS survey has identified a new ISM molecule, an isomer of methyl formate, toward Sgr B2.
- These results highlight the synergy between laboratory chemistry and astrochemistry.
- The difference in the rotational temperatures of the two conformers of methyl formate suggests that they have different spatial distributions in this source, or the system is not in thermodynamic equilibrium.



Lab spectra (red) of methyl formate, and Sgr B2 data from the GBT (Neill et al. 2012)



C. Carilli w/ input from Lockman

Title: Laboratory and Tentative Interstellar Detection of Trans-Methyl Formate Using the Publicly Available Green Bank Telescope Primos Survey

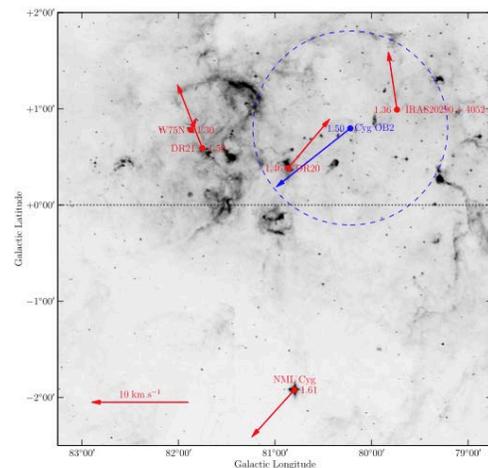
Web link: <http://adsabs.harvard.edu/abs/2012ApJ...755..153N>

Publication: Neill et al. 2012ApJ...755..153N

## VLBA: distance and size of a hypergiant star

- Zhang et al. determine the proper motion of the red hypergiant star NML Cyg using water and SiO masers, as well as the photospheric continuum
- The proper motion is  $0.620 \pm 0.047$  mas, corresponding to a distance of  $1.61 \pm 0.13$  kpc, putting the star in the Cyg OB association
- They also measure a size for the radio photosphere at 43GHz of 44mas

MSX 8  $\mu\text{m}$  image of the Cygnus X region overlaid with the peculiar motions for maser sources with parallax and proper motion measurements. The dotted line indicates the Galactic plane. Distances in kpc are listed.



Title: The distance and size of the red hypergiant NML Cygni from VLBA and VLA astrometry

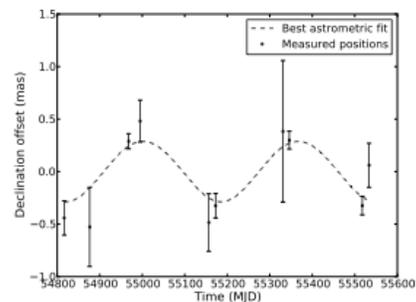
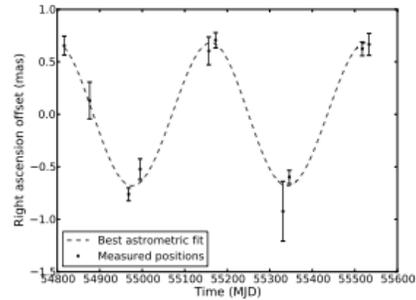
Web link: <http://adsabs.harvard.edu/abs/2012A%26A...544A..42Z>

Publication: Zhang et al. 2012A&A...544..42

## VLBA: distance and mass of a transitional ms pulsar

- Deller et al. use the VLBA to measure a direct parallactic distance to the transitional millisecond pulsar J1023+0038
- Variable Xray emission from this system indicates it is in the crucial, short-lived evolutionary phase of mass transfer from the stellar companion which leads to the high spin-up of the neutron star to generate a ms pulsar.
- From the parallax ( $0.731 \pm 0.022$  mas) and proper motion ( $17.98 \pm 0.05$  mas/yr), and using previous optical observations, they derive a distance of 1368 pc, a neutron star mass of  $1.71M_{\odot}$ , and a 3D space velocity of 126 km/s.

The parallax signature in RA and DEC (proper motion subtracted).



C. Carilli w/input from Frail/Briskin

Title: A Parallax Distance and Mass Estimate for the Transitional Millisecond Pulsar System J1023+0038

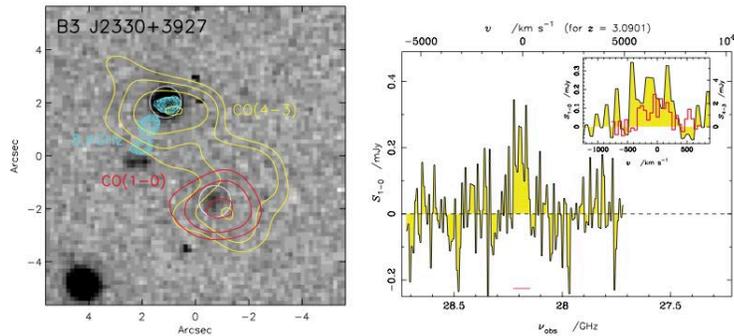
Web: <http://adsabs.harvard.edu/abs/2012ApJ...756L..25D>

Publication: Deller et al. 2012ApJ...756L..25D

## JVLA: Imaging molecular gas in forming massive galaxies

- Ivison et al. image the CO emission from two radio galaxies at  $z=3$  using the JVLA and PdBI
- The results indicate extreme, dense starbursts in complex, merging gas rich galaxies
- They see evidence for AGN feedback on the molecular gas through enhanced turbulence and high CO excitation

JVLA and PdBI spectra and images of a radio galaxy  $z=3$  (Ivison et al. 2012)



C. Carilli w/input from Frail

Title: Gas-rich mergers and feedback are ubiquitous amongst starbursting radio galaxies, as revealed by the VLA, IRAM PdBI and Herschel

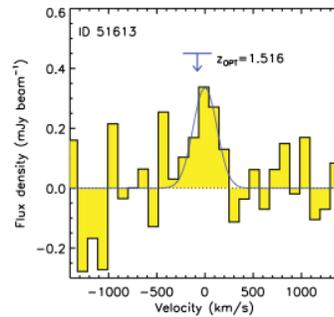
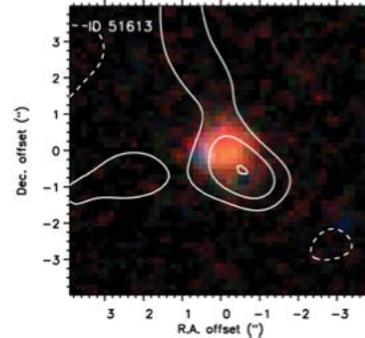
Web link: <http://adsabs.harvard.edu/abs/2012MNRAS.425.1320I>

Publication: Ivison et al. 2012, MNRAS, 425, 1320

## JVLA: imaging molecular gas in early disk galaxies

- Aravena et al. surveyed a group of star forming disk galaxies at  $z=1.5$  for CO 1-0 emission with the JVLA. Two known group galaxies are detected in CO emission.
- They also perform a blind search of the wide JVLA band, and find CO emission from two other galaxies in the field.
- These observations demonstrate that star forming disk galaxies during the peak epoch of cosmic star formation contain large masses of molecular gas, without extreme starbursts.
- The gas masses are greater than the stellar masses, indicating a fundamental change in galaxy properties during the epoch of galaxy assembly.

JVLA CO 1-0 image and spectrum of a  $z=1.5$  disk galaxy



C. Carilli w/input from Frail

Title: Deep observations of CO line emission from star-forming galaxies in a cluster can

Web link: <http://adsabs.harvard.edu/abs/2012MNRAS.426..258A>

Publication: Aravena et al. 2012MNRAS.426..258A

## Agenda

- Science Results
- Observatory Science Operations
  - Data Management
  - Facility-based Activities
  - Shared Services
  - Training the Next Generation
  - Metrics
- Observatory Telescope Operations
- Observatory Development & Programs
- Broader Impact
- Observatory Administrative Services
- Director's Office



## Observatory Science Operations - Data Management (1 of 6)

- **Archives/Data Access**

- 14 ALMA projects distributed to 13PIs through NAASC mirror archive
- VLA Pipeline products to be made generally available through the AAT – *NOT COMPLETE*
  - *RISK: (LOW)* Data reduced by the VLA pipeline will not be available through the AAT pending further validation tests of the pipeline products
  - *MITIGATION:* Raw VLA data products are still available through the AAT and users can request data reduction assistance through f2f visits or the NRAO helpdesk
- Internal testing of batch re-processing of VLA data through prototype web interface in the AAT – *NOT COMPLETE*
  - *RISK: (LOW)* Development of the data reprocessing interface has been delayed due to personnel staffing and the need to focus on higher priority items during FY 2012
  - *MITIGATION:* VLA Pipeline scripts are available to be run offline in CASA.



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

ALMA Cycle 0 observations continued through Q4 FY12. In this time, **14 projects (24 datasets) were delivered to 13 North American or Chilean PIs**. The data transfer took place through the NAASC mirror of the ALMA archive. Correspondence with the PIs during the data delivery continued to take place through the ALMA helpdesk.

The distribution of **VLA pipeline data products in Q4 was delayed pending further evaluation of the data products** by scientific staff working on the pipeline scripts and heuristics. The risk of not reaching this milestone is low as all the raw data taken from the VLA are immediately available to users through the AAT. Furthermore, a copy of all VLA data is archived in Charlottesville. This milestone was achieved in Q2 FY12.

The development of a **data reprocessing interface was delayed in FY2012**, as VLA software personnel were transferred to working on the observatory-wide software infrastructure for proposal handling and time allocation to cover for an open position that has not yet been filled. The impact and risk of the lack of a data reprocessing interface is low, since users will have access to the pipeline scripts if needed. The ability to modify key input parameters for the pipeline was developed in Q4, and will undergo testing in FY 2013 Q1.

## Observatory Science Operations - Data Management (2 of 6)

- **Archives/Data Access (continued...)**
  - Start supporting new GBT data in the NRAO archives and provide access to the data through the AAT.
    - Evaluation of AAT files
    - Creation of AAT database loader
    - Regular rsync of bulk data and databases
    - Ongoing generation and testing of metadata database / loading
    - Utilize test server for AAT interface
    - Internal staff testing and evaluation



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

The GBT Archive access group completed the work on the GBT Archive access project in Q4 FY12. Over the course of Q4, **extensive evaluation and testing took place on accessing the GBT data through the AAT** (<http://archive.nrao.edu>). This included **creation of a database loader** to ingest GBT metadata into the existing AAT schema used for the VLA and VLBA. **Regular daily syncs of the GBT raw data and metadata began** between Green Bank and Charlottesville ensuring uniformity for data access. The **AAT access and user interface was tested by scientific staff** in Green Bank, Charlottesville, and Socorro. Feedback from testers was folded back into the operation of the AAT for improvement. The archive system and software was moved to the production server on October 1, 2012.

## Observatory Science Operations - Data Management (3 of 6)

- **Pipelines**

- All standard VLA observations are processed through the automated pipeline as they are observed
- Progress continued on defining ALMA pipeline procedures and heuristics
  - Updated pipeline installed at the NAASC in July. The most recent version, which includes calibration and some simple imaging, was also deployed in Chile.
  - Began validation process of script vs. pipeline data reduction – Reported differences to our European colleagues.
  - Monthly meeting started in Sept to coordinate testing across ALMA executives.



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

During Q4 the infrastructure to enable the automated processing of VLA data upon the completion of an observation was finalized. **All observations are now passed through the automated pipeline as they are observed**, although the output products are not currently archived pending further development of the pipeline heuristics and quality assurance metrics. The pipeline heuristic development in Q4 included improvements in how calibration solution intervals are determined. The major remaining outstanding items are: (1) the automated identification and flagging of bad data due to system level problems (poor performing antennas, deformatter alignment issues, etc.), and (2) more robust determination of the flux density scale (requires development in CASA, which will be available in the new CASA 4.0 release, FY2013 Q1). We do not plan on making pipeline products available through the NRAO archive interface until these two items have been addressed. It is still the plan for pipeline products to be made available for the beginning of the D configuration, January 2013.

An updated ALMA **pipeline was installed in early July at the NAASC and in Chile** that addressed a major bug seen during initial testing. The pipeline team also completed a campaign of identifying candidate projects that have observed enough Obs Unit Sets to run successfully on the pipeline and **started the process of comparing data reductions done by scripts (via the QA2 process) with the output of the pipeline**. This supported the European effort by comparing the differences in UV coverage between the “by-hand” QA2 process and the science pipeline. Reason for the differences reported to European colleagues. A **monthly meeting** (opposite the monthly tester/developer meeting) consisting of only the pipeline testers (Europe, Chile, and North America) **kicked off on September 26th**. The focus of this meeting is to plan and coordinate testing across the three sites, and to discuss test results. This feeds into the combined tester/developer meeting.

## Observatory Science Operations - Data Management (4 of 6)

- **Pipelines (continued...)**

- Integration of new 4mm receiver and new spectrometer (VEGAS) into GBT data reduction pipeline
  - Improvements to calibration stage of GBT pipeline
  - Updated user interface, online documentation and user's guide for GBT pipeline
  - Implemented ModificationRequest 14Q112, multiple SDFITS input in support of VEGAS
  - Updated pipeline for RHEL6 OS upgrade
  - Initial development of parallel imaging code with AIPS
  - SDFITS was converted to handle data from the new 4mm Rx (MRQ212).



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

Work continued to progress on the GBT pipeline. During Q4FY12, major speed and memory efficiency **improvements were made to the calibration stage of the GBT pipeline**. Updates to the calibration equations were made after discussion with GB scientific staff. Also, **new updates to the user interface, online documentation and user's guide were completed**. In support of the new VEGAS Spectrometer, the GBT Pipeline team **implemented ModificationRequest 14Q112** which allows the import of multiple SDFITS files into the pipeline. Finally, the **GBT Pipeline source code was updated for RHEL6 OS upgrade and the initial development of parallel imaging code with AIPS was started**. Bob Garwood worked on **converting SDFITS to handle data from the new 4mm Rx (MRQ212)**, which is the first step towards pipeline processing. Initial data reduction scripts were generated by the 4mm receiver Project Scientist to reduce data taken from the new receiver. There are no concerns to eventually translating these scripts into the general GBT Pipeline source code.

## Observatory Science Operations - Data Management (5 of 6)

- **High Performance Computing**
  - Additional 100TB of Lustre storage installed at the NAASC
  - Benchmarking of VLA and ALMA imaging nearing completion
  - Specification of VLA and NAASC post processing cluster and JAO pipeline cluster on schedule for FY2013 Q1
  - VLA Cluster scheduler functional and supports pipeline and interactive modes
- **Post-Processing Software Development**
  - CASA development and testing continued in preparation for the next public release in FY2013 Q1



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

Charlottesville held off on purchasing the ALMA archive and cluster expansion (not needed yet), but did **buy another 100TeraBytes of Lustre file storage** to support pipeline testing and QA2 data processing.

Non-imaging benchmarks are complete; **EVLA and ALMA imaging benchmarks are nearly complete**. While they are roughly a month behind schedule they should not impede the **scheduled purchase of the EVLA and NAASC post processing clusters** or the JAO pipeline cluster. A full report of CASA parallel performance and system recommendations will be made available on the Web in FY2013 Q1. The **VLA cluster scheduler is fully functional** and support pipeline and interactive modes. Further tuning of prioritization will be done throughout the year as necessary.

The most recent version of CASA was released in Q3 FY12. In Q4, **plans continued to be developed for the next CASA release scheduled in Q1 FY13** including enhancements to data calibration and to the CASA viewer.

## Observatory Science Operations - Data Management (6 of 6)

- **Algorithm Development**

- Replacement of multi-scale deconvolution algorithm with Asp-Clean - *NOT COMPLETED*
  - *RISK (LOW)*: Modification to memory footprint of ms-mfs reduced need for this
  - *MITIGATION*: NONE – not necessary as this is strictly R&D.
- GPU testing with new algorithms initiated with nVIDIA
- Wideband A-projection tested



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

The use of the current multi-scale algorithm for high resolution high-dynamic range imaging of complex fields was being limited by its memory footprint. This implementation was modified to reduce the memory footprint making it usable for even larger fraction of problems, **reducing the need to investigate replacing it with Asp-Clean**. Deployment of Asp-Clean has therefore been deferred. Instead, development focused on merging the research and development (R&D) code branch with the production Common Astronomy Software Applications (CASA) code base.

**Discussions with the nVIDIA group were initiated** to evaluate run-time gains if Graphics Processing Unit (GPU) computing is used with the new algorithms. Efforts are underway to see if staff from nVIDIA can do a proof-of-concept prototype using some of our code to help make a better assessment of cost-gain equation.

Ideas for a wide-band **A-projection algorithm**, which corrects for the time-dependent rotation of the primary beam on the sky, **were tested** in the (R&D) code branch.

## Observatory Science Operations - Facility-based Specific Milestones - ASC

- **Face-to-face Visitor Support**
  - In Q4 the DSOC welcomed 50 visitors, of which 3 were colloquium speakers, 11 RSRO scientists, and 36 other scientific visitors
- **Observation Support**
  - Version of the OPT incorporating the correlator set-ups to be made available at the beginning of EVLA full operations released for testing.
    - Test version of the OPT updated to support setting up 8GHz BW observing
    - Test OPT updated with all Full Science Operations correlator set-ups
    - Speed improvements to OPT completed



T. Bastian/T. Remijan w/ input from Chandler

In Q4 FY12 **NRAO-NM** hosted a total of **50** visitors including **11 RSRO** scientists and **36** scientific visitors and **3** colloquium speakers.

The test version of the VLA Observation Preparation Tool was **updated during Q4 to support the setting up of 8 GHz bandwidth** observing using the 3-bit samplers. This version will be tested during FY2013 Q1 and deployed for the D-configuration that starts in January 2013. The same **test version of the OPT also includes all the correlator set-ups offered for general observing**. A significant **speed-up was obtained in the OPT performance** by migrating to a more modern version of the underlying Postgres database, which dealt with some issues that had been reported by users.

## Observatory Science Operations - Facility-based Specific Milestones - NAASC

- **Face-to-face Visitor Support**

- Steve Warren from University of MD visited the NAASC on a data reduction visit

- **Science User Outreach**

- The Interstellar Medium in High Redshift Galaxies Comes of Age (Charlottesville, Virginia, 13-15 September 2012)
- ANASAC face-to-face 20-21 September in Charlottesville.



T. Bastian/T. Remijan w/ input from Wootten

Steve Warren from University of Maryland **visited the NAASC to work with staff** in association with project 2011.0.000172.S

In Q4, from **September 13-15, 2012, A NAASC workshop titled "The Interstellar Medium in High Redshift Galaxies Comes of Age"** was held at the NRAO in Charlottesville, VA in honor of the 20th anniversary of the detection of CO emission from a galaxy at  $z = 2.3$  using the NRAO 12m telescope in 1991. The 62 registered participants discussed the view into the evolution of galaxies and the Universe which these difficult observations provide. The event also focused on the scientific contributions and leadership of former NRAO Director Paul Vanden Bout. The complete science program is on-line at <https://science.nrao.edu/facilities/alma/naasc-workshops/HizISM/index>.

The **ANASAC held a face-to-face meeting 20-21 September in Charlottesville**. The use experience of the proposal Call was discussed, along with various topics related to the science use of ALMA, and to the ALMA Development program

## Observatory Science Operations - Shared Services

- **Proposal Process**

- Call for proposals for semester 2013A issued
  - All VLA, VLBA, and GBT user documentation updated
- Proposal submission deadline for 2013A
  - PST, sensitivity calculators, correlator set-up tools, etc., updated
  - 420 proposals received, 253 for VLA, 76 for VLBA, 91 for GBT
  - Technical reviews for all proposals completed
  - Community-based science reviews for all proposals organized
- ALMA Call for Proposals received 1133 submissions



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

In Q4 both ALMA and NRAO North American facilities had a deadline for proposal submission. In support of the NRAO 2013A proposal submission deadline, **all user documentation for the VLA, VLBA and GBT were updated**. Also, the **Proposal Submission Tool (PST) was updated** to accommodate the new correlator modes and observing settings. In total, **420 proposals were submitted by PIs** to use the NRAO NA facilities. Also over the course of Q4, **all scientific and technical reviews were completed in support of the proposal submission process**. Finally, the ALMA Proposal deadline was on 12 July 2013. At this time, **ALMA received 1133 proposals across all executives**. The science review panel and time allocation committee will be meeting in Q1 FY13.

## Observatory Science Operations - Shared Services

- **Observing Prep Tools**

- Incorporate elements of the Splatologue database into the EVLA and GBT observation preparation software and analysis systems.
  - **RISK (LOW):** Interface between the OPT and Splatologue is delayed in support of additional programming necessary for the OPT.
  - **MITIGATION: NONE** Users can still use the online Splatologue interface to set up spectral line observations.

- **Helpdesk**

- Single sign-on for ALMA and NRAO helpdesks not completed due to cross-authentication issues on the ALMA side
  - **RISK (LOW):** Currently users of the ALMA Science Portal and NRAO User Portal have to uniquely authenticate to submit helpdesk tickets for each facility
  - **MITIGATION: NONE** - users will continue to log on to helpdesks separately for NRAO and ALMA



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

An interface between the **OPT** and **Splatologue** was delayed in support of additional programming requirements for the OPT. There is no risk associated with not hitting this milestone as the online Splatologue interface still enables users to select spectral lines to set up observations.

**Progress was stalled on the Single sign-on (SSO-2) authentication between ALMA and NRAO users.** This was primarily due to a change in personnel assigned to the SSO-2 team in Europe. The risk of not meeting this milestone is low in that currently ALMA and NRAO users have to authenticate through independent user portals. A delay of 1 quarter for SSO-2 is currently anticipated so it is planned that SSO-2 will be ready to be deployed in January, although we may want to choose a later time for extensive testing. **NOTE:** Integration of Green Bank into the NRAO helpdesk took place in Q1 FY12 (see appendix).

## Observatory Science Operations - Shared Services

- **Science Community Communications**

- Represent NRAO at AAS, IAU, and AAAS meetings [Q2, Q3, Q4]
  - International Astronomical Union General Assembly: Beijing, China 19-31 Aug
    - Participated as exhibitor and sponsor
  - American Astronomical Society scheduled approved NRAO sessions for Jan 2013 Long Beach
    - NRAO Town Hall: Tue evening, 8 Jan, 6:30-8:30 pm
    - ALMA/NAASC Special Session: Tue afternoon, 8 Jan, 2-3:30 pm
    - NRAO will also participate as an exhibitor and sponsor of the Undergraduate Orientation
- Represent at NSBP/NSHP
  - Visit from Lawrence Norris - the managing director of NSBP



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

The NRAO participated in the **IAU General Assembly in Beijing China, 19-31 Aug** as a **exhibitor and overall sponsor** of the General Assembly. The final **schedule for the Jan 2013 (Long Beach, CA) AAS meeting was approved**. The final list of events that will be hosted by NRAO at the AAS meeting include the **NRAO Town Hall on 8 Jan**, the **ALMA/NAASC Special Session** will feature 6 speakers and will take place in the afternoon of 8 Jan and NRAO will also participate as an **exhibitor and sponsor at the undergraduate reception and orientation**.

**Lawrence Norris who is the managing director of the NSBP visited the NRAO in Charlottesville**. During that visit, he interviewed the new NRAO Director Tony Beasley and met with the Howard students who were taking part in the NRAO REU summer research program. Dr. Norris also attended a four part lecture series held by Kartik Sheth of the NAASC on "being a minority in a majority field." We also helped edit some stories for him for the "Waves and Packets" magazine.

## Observatory Science Operations - Shared Services

- **Science Web**

- Web Developer replacement hire process complete.
- Complete the conversion of the GBT, EVLA and VLBA content and user documentation to PLONE
  - VLBA Observational Status Summary converted to Plone
  - Good progress made on converting the OPT manual to Plone, to be completed in time for D-configuration, January 2013
  - Progress made on converting the GBTIDL guide into Plone.



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

In Q4 the **COM web developer position was filled**. Davis Murphy arrived 24 Sep 2012. Plone has been accepted as the revision control platform for all NRAO websites and documentation. Over the course of FY12, a systematic effort was put in place to update and revise all existing and relevant online documentation for the VLA, VLBA and GBT into Plone. In Q4, the **VLBA Observational Status Summary (OSS), the main document describing its instrumental capabilities in detail, was moved to PLONE** and is now available off the VLBA web pages. In addition, **significant progress was made in converting the OPT manual to Plone** which should be released in time for D-configuration in January 2013. A **dedicated effort started converting the GBTIDL guide into Plone**. The full conversion of all documentation should be completed in FY13.

## Observatory Science Operations - Shared Services

- **VAO**
  - Begin prototyping VAO access to ALMA data as well as that from NRAO's North American telescopes
    - Initial ALMA metadata defined; development of related VAO services underway
- **Metrics and Statistics**
  - Enhancements to and integration with other databases completed.
    - Infrastructure was put in place to include information from the ALMA databases on proposal submissions
- **User Education and Training**
  - VLA Community Day held at ASIAA in Taipei, Taiwan



T. Bastian/T. Remijan w/ input from Chandler/O'Neil/Wootten

**Initial metadata for the ALMA science archive has been defined** which is capable of describing ALMA data products in relational tables to support both native ALMA queries as well as add-on VO services. NRAO is providing input to VAO to help define VO interfaces for accessing the large spectral data cubes produced by ALMA and EVLA. Development (funded by VAO) of a service framework for implementing VO services is underway. When completed this will be used to implement VO services for selected initial NRAO datasets. NRAO is also participating in development of Python and other client interfaces for access to remote data via the VO framework. This software will later be used to VO-enable CASA.

The metrics databases have been **enhanced to provide additional queries about proposals and to include information** derived from ALMA databases.

**A VLA community day was held at ASIAA in Taipei, Taiwan, on September 3 and 4, 2012.** The goal of the workshop was to introduce the capabilities of the new VLA and raise the awareness of this new instrument in the Taiwanese astronomical community. In addition to talks that highlighted the technical capabilities of the VLA by NRAO staff, science talks were presented by both NRAO staff and Taiwanese astronomers. There were about 40 attendees for the talks that took place on the first day and during the morning session of the 2nd day. The afternoon of the 2nd day was fully dedicated for hands-on sessions for OPT and CASA. About 20 people participated in the hands-on sessions.

## Observatory Science Operations - Training the Next Generation

### Community Support Programs

- **Undergraduate Student Programs**
  - Summer students
    - Twenty-five undergraduate and graduate students finished their summer 2012 appointments at the three NRAO sites
    - Approved support requests for 14 2012 summer students to present their results at the 221<sup>st</sup> AAS meeting in January 2013 to be held in Long Beach, CA
  - Co-operative Education Students
    - One Co-Op student finished his appointment at NRAO GB
    - One Co-Op student finished his appointment at NRAO SOC
    - One Co-Op student finished her appointment at NRAO CV
  - Undergraduate Internships
    - One undergraduate continued his undergraduate internship in Socorro



T. Bastian/T. Remijan w/ input Mangum

Summer Student Program: 25 summer student internship appointments finished (SOC/GB/CV = 6/8/11)

Co-Op: Three **Co-Op students** finished their appointments (Robyn Smith (CV), James Duncan (GB), and Brian Castillo (SO)).

**Undergraduate Interns:** One undergraduate in Socorro continued his undergraduate internship working in the Electronics Division in Socorro: Orlando Lopez.

## Observatory Science Operations - Training the Next Generation

- **Graduate Student Programs**
  - Graduate Student Internships
    - Seven graduate students either started or continued work as graduate interns with NRAO mentors
  - Reber Fellowship Program
    - Shanghai Observatory student continued appointment working in Charlottesville
    - New Mexico Tech student continued appointment working in Socorro
    - University of Virginia astronomy student continued appointment working in Charlottesville
    - Two University of Virginia engineering students continued appointments working in Charlottesville
- **Visiting Astronomers**
  - Seven visitors in Socorro (5) and Charlottesville (2)



T. Bastian/T. Remijan w/ input Mangum

### **Graduate Interns:** Eight 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
- Dana Ficut-Vicas (University of Hertfordshire) continued her project working with Michael Rupen on the Little Things project.
- Joanna Corby (University of Virginia) started her project working with Anthony Remijan on astrochemistry.
- Laura Perez (Caltech) worked with Claire Chandler on star formation
- Ahahi Caidu-Primo (MPIA) worked with Adam Leroy and Juergen Ott on extragalactic star formation.
- Sierra Smith (JMU) worked with Ellen Bouton on radio astronomy history.
- Kimon Zagkouris (Oxford University) worked with Paul Demorest on pulsars

### **Reber:** Five graduate students participated in the Reber Doctoral Fellowship program:

- Feng Gao (Shanghai Observatory) continued his PhD research working w/ 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 working with Fraser Owen.
- Charles Romero (Uva) started his appointment working with Brian Mason.
- Michael Cyberey (Uva engineering) started his appointment working with Tony Kerr and Art Lichtenberger
- Greg Stonko (Uva engineering) started his appointment working with Tony Kerr and Art Lichtenberger

### **Visiting Astronomers:**

- Christopher Stockdale from Marquette University continued a two-month visit to NRAO SOC which began in June 2012.
- Paul Martini from Ohio State continued a one-year visit to the NAASC at NRAO CV which began in June 2012.
- Leslie Looney from University of Illinois began a one-year visit to the NAASC in NRAO CV which began in July 2012.
- David Roberts from Brandeis University started a five-month visit to NRAO SOC which began in August 2012.
- Vernesa Smolic from Argelander Institute for Astronomy started a one week visit to NRAO SOC which began in September 2012.
- Sergei Gulyaev from Auckland University of Technology started a one week visit to NRAO SOC which began in September 2012.
- Robert Mutel from University of Iowa started a 3.5 month visit to NRAO SOC which began September 2012.

## Observatory Science Operations - Training the Next Generation

- **Library**

- Rolled out new OPAC Discovery for the NRAO Library catalogue
- Replaced Chat Reference service
- Revised Publication Support
- Over 1500 records were added to NRAOPapers or to NRAOTheses
- Completed the QC process of outsourced memo scanning
- Began and continues its realignment and review of responsibilities due to staffing changes during this quarter



T. Bastian/T. Remijan w/ input from Bishop

In Q4, the library provided several new services and replaced old or outdated services including **rolling out new OPAC Discovery for the NRAO Library catalogue** which allows use on mobile devices; **replaced Chat Reference service** after prior service was discontinued and **revised Publication Support Form to include e-mail validation** due to the number of requesters who entered their email address incorrectly. In this period, over **1500 records were added to NRAOPapers (the NRAO papers bibliography) or to NRAOTheses** during this quarter. The **library completed the quality control process of outsourced memo scanning**. Finally, the NRAO Library **began and continues its realignment and review of responsibilities** due to staffing changes during this quarter

## Observatory Science Operations - Training the Next Generation

- **Historical Archives**

- Sierra Smith continued in the Archives as a Graduate Intern
- Digitized photos from our collection were submitted to the Canto Cumulus database
- Processing continued on the Papers of Donald C. Backer
- annual summer student lecture introducing students to archives
- the CV Computing Division to make the video editing station in the Archives operational has been completed
- A German film crew used the archives to record footage for an ALMA documentary.



T. Bastian/T. Remijan w/ input from Bouton

**Sierra Smith continued in the Archives as a Graduate Intern**, transcribing Woodruff T. Sullivan's digitized audio interviews of 20th century radio astronomers. She has also begun scanning and OCRing some of the ~50 typescripts of interviews Sullivan had transcribed.

The Archives made available a **large set of digitized photos from our collection for loading into the Canto Cumulus database** being built by Alex Bolling as part of a joint EPO-Archives project to index and make accessible our large collection of multi-media materials. Testing of the database has begun.

Additional VLBA materials donated by Kenneth I. Kellermann were incorporated into the existing collection. **Processing continued on the Papers of Donald C. Backer.**

The **annual summer student lecture introducing students to archives** in general and the NRAO Archives in particular included a tour of the Archives. The annual showing of the films on the construction of the 300 foot and 140 foot telescopes took place in June.

Work by the **CV Computing Division to make the video editing station in the Archives operational has been completed. A German film crew working with EPO used the Archives for a week in August to film interviews of staff for a movie on ALMA.**

Finding aids for the Archives collection and the Archives online catalog are linked from the NRAO Archives home page, <http://www.nrao.edu/archives/>.

## Telescope Usage (Astronomy, Downtime, Maintenance, Test/Calibration, Unscheduled)

ALMA FY12Q4		July	August	September
ALMA	Scheduled	529.7	303.1	226.6
	Astronomy	270.6	142.7	127.9
	Downtime	259.1	160.4	98.7
	Maintenance	-	-	-
	Test	-	-	-
	Unscheduled	1,678.3	440.9	537.4
	Shutdown	-	-	-
	Total Hours	2,208.0	744.0	744.0

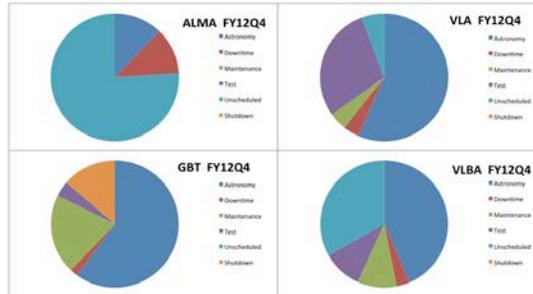
GBT FY12Q4		July	August	September
GBT	Scheduled	1,371.5	417.5	351.5
	Astronomy	1,324.8	386.3	347.0
	Downtime	44.7	31.2	4.5
	Maintenance	442.2	186.0	351.0
	Test	85.8	19.5	39.0
	Unscheduled	-	-	-
	Shutdown	303.5	121.0	183.5
	Total Hours	2,208.0	744.0	744.0

VLA FY12Q4		July	August	September
VLA	Scheduled	1,339.7	456.9	481.0
	Astronomy	1,290.6	418.0	433.4
	Downtime	89.1	38.9	23.6
	Maintenance	98.1	34.8	30.8
	Test	643.8	193.8	208.5
	Unscheduled	124.4	58.5	29.7
	Shutdown	-	-	-
	Total Hours	2,208.0	744.0	744.0

VLBA FY12Q4		July	August	September
VLBA	Scheduled	1,033.8	332.3	300.2
	Astronomy	893.0	308.7	277.6
	Downtime	74.8	25.6	23.7
	Maintenance	220.2	66.1	97.1
	Test	221.6	86.1	70.9
	Unscheduled	732.4	259.5	276.4
	Shutdown	-	-	-
	Total Hours	2,208.0	744.0	744.0



G. Hunt

**ALMA metrics**, now included in these reports are still incomplete. They will be enhanced and modified in subsequent reports.

Presented are the figures for the quarter. The figures are summarized in the pie charts. To give some perspective, the important metric of Scheduled Observing is presented for the last 13 months. For ALMA, this shows the ramp-up observing of all Cycle 0 proposals. For the other telescopes, there are no significant trends; monthly differences are within the usual monthly variations.

There were no observations with ALMA in September to install the final quadrant of the correlator and the Permanent Power Supply. The summer dip in the GBT is the annual outage for painting the structure. There is still a large allocation for test time due to EVLA commissioning. There is also a large allocation of test time to commission the wideband capabilities of the VLBA.

**Scheduled:** planned observing time

*Astronomy:* amount of hours observed by a proposal (“Observing Hours” in subsequent slides)

*Downtime:* amount of hours lost during observing

**Maintenance:** scheduled period for service for infrastructure, hardware and software

**Test:** test observations, not peer reviewed proposals.

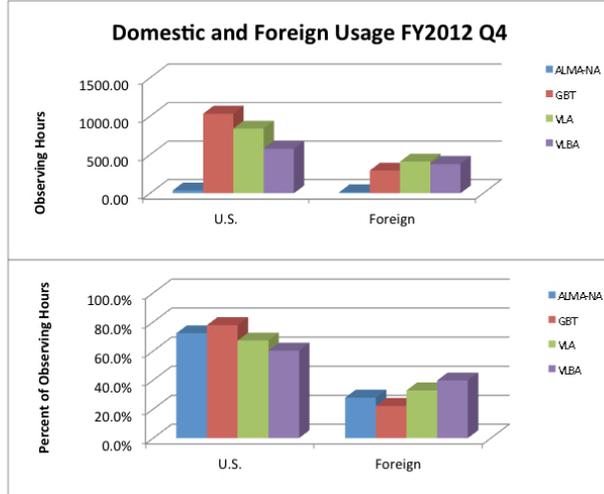
**Unscheduled:** idle time due to unschedulable gaps between observing programs and predicted extended inclement weather

**Shutdown:** usually a holiday. Other major shutdowns are for major equipment work, such as GBT structural painting or the VLA WIDAR correlator installation in 2010.

## Telescope Usage by Observing Hours Expended in terms of - US/Foreign Observers

	U.S.	Foreign	Unspecified
ALMA-NA	37.73	14.55	0.00
GBT	1032.75	294.00	0.00
VLA	839.93	410.81	0.00
VLBA	578.13	380.85	0.00

	U.S.	Foreign	Unspecified
ALMA-NA	72.2%	27.8%	0.0%
GBT	77.8%	22.2%	0.0%
VLA	67.2%	32.8%	0.0%
VLBA	60.3%	39.7%	0.0%



G. Hunt

Telescope usage distributed by national institutional affiliation of the *Principal Investigator*.

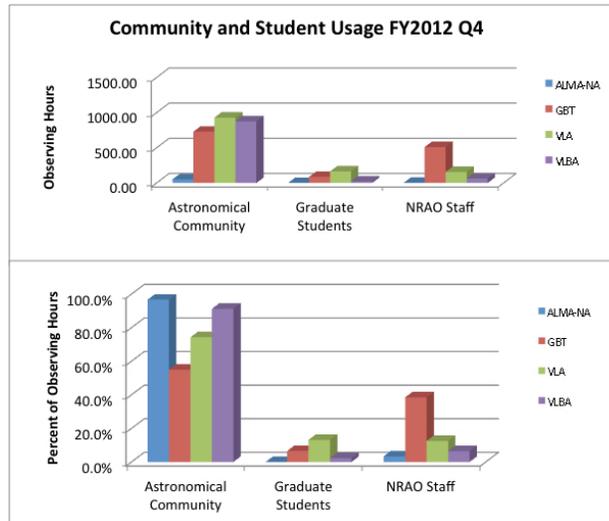
Note that this includes ALMA observations of North American proposals. The non-US proposals during this quarter were all from Canada.

There is no significant trend.

## Telescope Usage by Observing Hours Expended in terms of - Astronomical Community/Graduate Students/NRAO Staff

	Astronomical Community	Graduate Students	NRAO Staff
ALMA-NA	50.53	0.00	1.75
GBT	729.25	86.75	510.75
VLA	929.11	164.80	156.83
VLBA	875.14	22.12	61.71

	Astronomical Community	Graduate Students	NRAO Staff
ALMA-NA	96.7%	0.0%	3.3%
GBT	55.0%	6.5%	38.5%
VLA	74.3%	13.2%	12.5%
VLBA	91.3%	2.3%	6.4%



G. Hunt

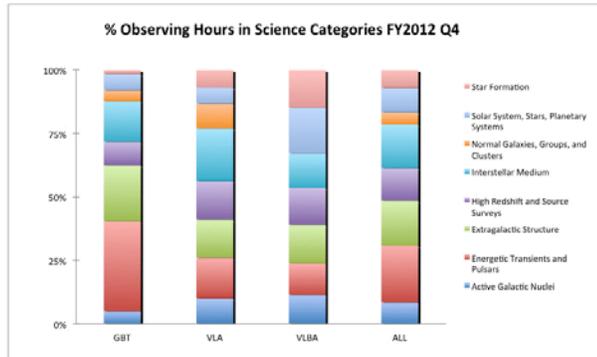
Telescope usage distributed by the scientific status of the *Principal Investigator*.

Note that this includes ALMA observations of North American proposals (The ALMA proposals do not include student identification.)

There is no significant trend.

## Observatory Science Operations - Telescope Usage by Science Category

	GBT	VLA	VLBA
Active Galactic Nuclei	4.8%	10.0%	11.3%
Energetic Transients and Pulsars	35.5%	16.1%	12.4%
Extragalactic Structure	22.0%	14.9%	15.3%
High Redshift and Source Surveys	9.3%	15.3%	14.6%
Interstellar Medium	16.1%	20.7%	13.6%
Normal Galaxies, Groups, and Clusters	4.2%	9.6%	0.0%
Solar System, Stars, Planetary Systems	6.4%	6.4%	17.9%
Star Formation	1.7%	7.0%	14.9%
Unspecified	0.0%	0.0%	0.0%



G. Hunt

NRAO proposals are considered in 8 distinct scientific categories. This shows the telescope usage by category in the last quarter. Although the total number of proposals is roughly uniform across all categories, it is clear that certain types of observing take different amounts of observing time on different telescopes.

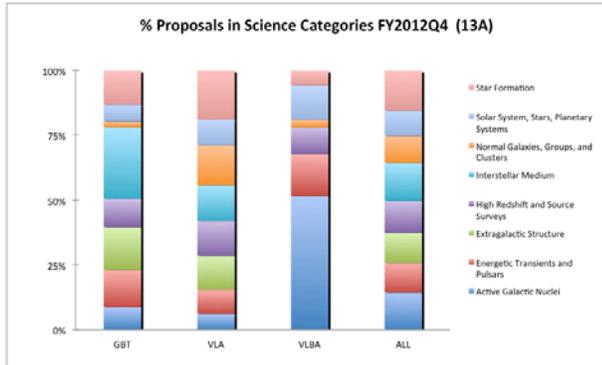
ALMA proposals are considered in 5 categories. ALMA observations are not included in this summary. The inclusion of the ALMA North American observations would not change this picture significantly, since they represent only 3% of the total hours observed by all telescopes in this period.

## Observatory Science Operations - Proposals Submitted during Reporting Period

	GBT	VLA	VLBA
Active Galactic Nuclei	8.8%	6.3%	51.5%
Energetic Transients and Pulsars	14.3%	9.1%	16.2%
Extragalactic Structure	16.5%	13.0%	0.0%
High Redshift and Source Surveys	11.0%	13.4%	10.3%
Interstellar Medium	27.5%	13.8%	0.0%
Normal Galaxies, Groups, and Clusters	2.2%	15.4%	2.9%
Solar System, Stars, Planetary Systems	6.6%	9.9%	13.2%
Star Formation	13.2%	19.0%	5.9%
Unspecified	0.0%	0.0%	0.0%

	Regular	Large	Total
GBT	87	4	91
VLA	245	8	253
VLBA	65	3	68
Global VLBI	8	0	8
All Instruments	405	15	420

Number Requesting Student Support: 40  
(39 Regular, 1 Large) (18 GBT, 18 VLA, 4 VLBA)  
Number Requested for Dissertation: 61  
(57 Regular, 4 Large) (22 GBT, 32 VLA, 7 VLBA)



G. Hunt

There was a very successful call for proposals, which closed on 1 August 2012, for NRAO Semester 13A to encompass observations to be scheduled between February 2013 and July 2013.

In this call, we received a record number of total proposals (420) as well as a record number of proposals for the VLBA (68). In addition, there were a record number of proposals in support of dissertations (61) and a record number of requests for student support (40).

## Observatory Science Operations - Data Serviced during Reporting Period

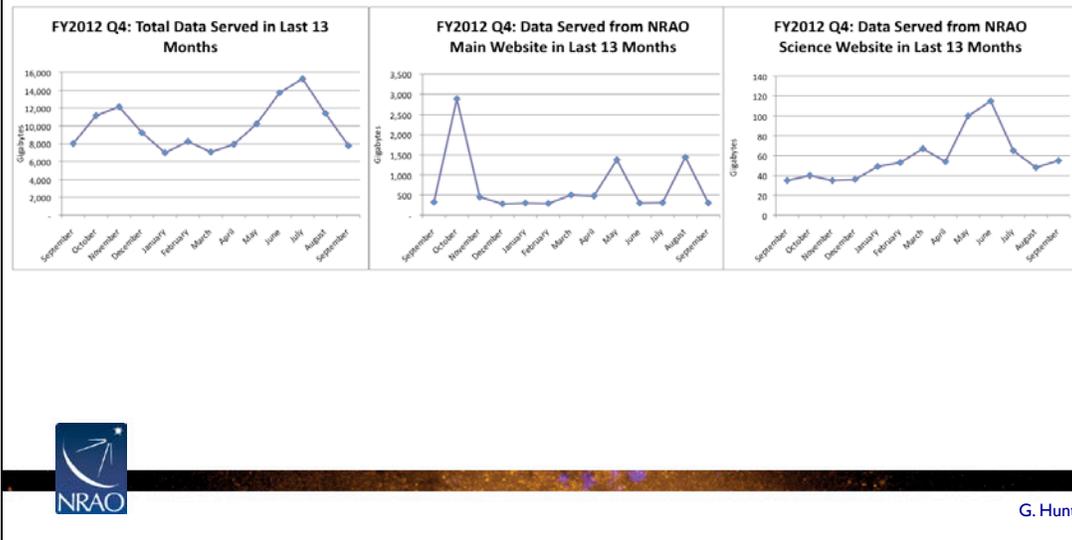


Chart 1. Total data served from all NRAO web servers.

Chart 2&3. Specific data for the main web site and for the science web site.

The main web site provides NRAO’s presence on the web. The science website is primarily in support of the observers.

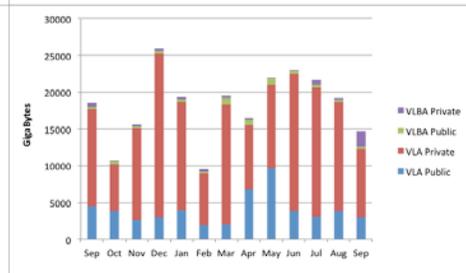
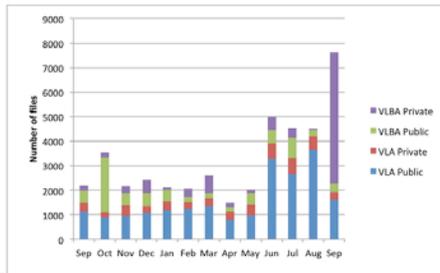
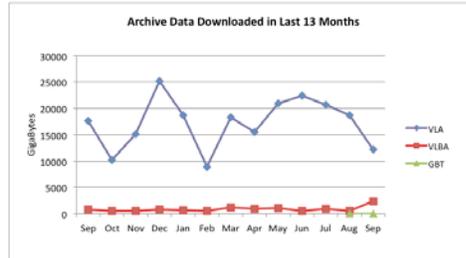
You can clearly see the response to the ALMA Opens Its Eyes announcement in October 2011. Although the increase in May was due to testing, there was a large increase in downloads of press releases in August.

Although the total traffic is modest, the recent increase in traffic from the science website shows increased use of the NRAO enews service.

To give some perspective, these are presented for the last 13 months.

## Observatory Science Operations - Archive Data Downloaded during Reporting Period

FY2012 Q4 Totals		
	# of Files	Data Volume (GB)
<b>GBT</b>		
Proprietary	64	30
Public	143	39
<b>Total</b>	<b>207</b>	<b>69</b>
<b>VLA</b>		
Proprietary	1,537	41,628
Public	7,907	9,948
<b>Total</b>	<b>9,444</b>	<b>51,576</b>
<b>VLBA</b>		
Proprietary	5,844	3,124
Public	1,403	873
<b>Total</b>	<b>7,247</b>	<b>3,997</b>
<b>Pipeline Images Downloaded</b>		
	<b>257</b>	



G. Hunt

This shows the data provided to the community by the NRAO Archive in Socorro. As a new capability formally announced on 1 October 2012, GBT data are now available via the NRAO Archive Access Tool (AAT; <https://archive.nrao.edu>). Thus data from the VLA, VLBA, and GBT are available with a single search and retrieval mechanism to the astronomical community. There are no significant trends.

To give some perspective, these are presented for the last 13 months.

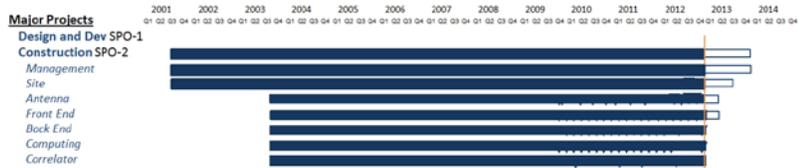
## Agenda

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



# Observatory Telescope Operations - ALMA Construction Project Schedule View

ALMA Major ALMA Construction Milestones



Mauricio Pilleux/Mark McKinnon

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 ALMA Annual External Review (AAER) [Q1]
    - Complete.



Mauricio Pilleux/Mark McKinnon

Management: The **ALMA Annual External Review (AAER)** was conducted in Santiago 17-20 October 2011 and reported in Q1.

## Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Site**

- Installation of power and fiber optics for the antenna stations in the extended array complete [Q3]
  - Phase IV stations completed in Q1 FY2012
  - AOS Utilities work scheduled for completion in late Q1 FY2013
    - Project completion as of September 30 estimated at 85%
    - Contractor delayed due to unusually bad summer weather conditions and demobilization for southern hemisphere winter
  - Arbitration with former contractor ended in AUI's favor
  - Legal proceedings with the insurance company holding the former contractor's performance bond are still in progress.
- AOS road construction contract delayed
  - 100% complete in Q3 FY2012
  - JAO acceptance process will occur in Q1 FY2013



Mauricio Pilleux/Mark McKinnon

Site: The **AOS Utilities Contract** is 85% complete. The milestone of the 5 km Array scheduled to be completed in Q4 FY2012 was achieved. This part of the Array is ready for Cycle I Science once accepted by the JAO, scheduled for November 2012. The overall schedule has slipped due to the bad weather experienced at the AOS and winter demobilization. However, the delay should not affect the completion of the ALMA Project. The **arbitration process** with the former AOS Utilities contractor came out favorable to AUI. The insurance company arbitration process is being refined in light of this favorable verdict.

**AOS Road Construction Contract** work is 100% complete. The ALMA acceptance process for the roads will be performed during Q1 FY2013.

## Observatory Telescope Operations - ALMA Construction Specific Milestones

### • Antenna

- Vertex antenna acceptance [Q1, Q2, Q3, Q4]
  - Vertex antenna #23 conditionally-accepted and delivered to the JAO (Aug 8)
  - Vertex antenna #24 conditionally-accepted and delivered to the JAO (Sep 12)
  - Vertex antenna #25 expected to be ready for acceptance on October 30
- Complete delivery of 6 OPTs [Q2, Q3]
  - Site acceptance testing of OPT Unit #3 completed; acceptance review pending
  - Site acceptance testing of unit #4 and #5 pending test per antenna availability
    - Initial site test efforts hampered by shutter hardware problems
  - Factory acceptance testing (FAT) of unit #6 to be completed in early Q1 FY2013
- Deliver Nutator units #1 through #5 [Q1, Q2, Q3, Q4]
  - Optimization of control software yielded satisfactory pointing results for most position angles and nutating frequencies
    - Technical specification relief via a change request is being pursued
  - FAT of Unit #1 now expected in late Q1 FY2013
    - Delivery of recoated subreflectors is now driving the nutator schedule
  - Delivery of additional 4 units through late Q1 or early Q2 FY2013



Mauricio Pilleux/Mark McKinnon

**Antenna:** During Q4 FY2012, the **23<sup>th</sup> and 24<sup>st</sup> Vertex antennas were conditionally-accepted** by the JAO. Pointing acceptance testing is scheduled to begin on 12 Oct for the **25<sup>th</sup> Vertex antenna**; this represents a delay of approximately 1 month as a result of delivery delays associated with encoder and HVAC hardware components to the site; acceptance review for Antenna 25 is tentatively planned 29 October.

**Production OPT (POPT):** Acceptance Review pending completion of Test Reports and Documentation. **POPT Units #4 and #5** on-site but Site acceptance testing delayed as a result of shutter hardware and software issues; hardware issues linked to loosened clutch torque spring on shutter drive motor. Software issue (which closes shutter prematurely) is still under investigation. FAT of **POPT Unit #6** delayed pending resolution of issues on Units #4 and #5.

**Nutator:** Continue to work with ALMA Science for possible relief from Nutator Technical Specification requirements of the few problematic pointing areas associated with pointing accuracy and settling time at the upper ranges of throw-angle and nutating frequency. Results from preliminary residual torque tests indicate that residual torque (reactions to supports) are within specification. FAT has now been delayed until late October 2012. With a successful FAT, **delivery of Nutator Unit #1** to Chile would be in mid- to late-Q1 FY2013 for on-site engineering and interface tests (PAS).

## Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Antenna**

- Deliver second FE Service Vehicle (FESV) [Q1]
  - Second FESV was delivered to OSF in December 2011; complete
- Deliver FE Handling Vehicles (FEHV) [Q1]
  - CDR conducted in December 2011
  - Antenna IPTs confirmed antennas can accommodate excess weight of FEHV
  - Units expected to be delivered during 10 months after FEHV additional budget is approved
    - This is a potential descope



Mauricio Pilleux/Mark McKinnon

Antenna: PAS of the second (of two) **Front End Service Vehicles (FESV)** was passed at the OSF in December 2011.

CDR of the **Front End Handling Vehicle (FEHV)** was performed in December 2011. The design exceeds the specified maximum weight for the antenna platform (450 kg was specified, design requires 680 kg). Antenna IPTs have accepted the additional weight and confirm that the FEHV can proceed as designed. Delta CDR expected in Q1 FY2013. Delivery of FEHV units (4) is now expected to occur during 10 months after additional budget is approved. Currently, the delay poses no risks as other methods exist to install/remove FEs.

## Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Front End**

- Deliver Integrated Front Ends to OSF [Q1, Q2, Q3]
  - FE #20 & 21 shipped to OSF during Q4
  - FE #22 Passed PAI during Q4
- Deliver all Local Oscillator Warm Cartridge Assemblies (WCAs), including spares, for ALMA Bands 3, 6, 7, and 9 [Q1]
  - B3, B6, B7 & B9 WCAs 100% complete during Q2
- Deliver all Cold Cartridges Assemblies for Bands 3 and 6, including spares, to the three ALMA FEICs [Q2]
  - B3 CCA 100% complete during Q2
  - B6 CCA 100% complete during Q4
- Deliver FE Components
  - Delivery of most NA FE components is complete
  - Critical design and manufacturing readiness review for the Thermal Interlock Module (FETIM) was successfully completed on June 19
    - FETIM production will be complete in Q1 FY2013



Mauricio Pilleux/Mark McKinnon

Front End: **Front End Assemblies:** last delivery (FE#22) passed PAI and received authorization to ship. However, it was agreed to delay actual shipment until November 2012 in order to use this FE to verify performance of the FE Test and Measurement System that will be shipped to the OSF in Q1 2013. **Local Oscillator Warm Cartridge Assemblies:** Final delivery of NAOJ Warm Cartridge Assemblies for Bands 4 & 8 are on track to finish at the end of Q1 FY 2013, Band 10 WCAs will finish at the end of Q2 FY2013, which corresponds to the end of the Japanese FY as required in the NAOJ Goods and Services Contract. **Cold Cartridge Assemblies: Band 6** mixer/preamp yield rate improved and the Band 6 team finished production at the end of August. **FE Components:** all B3, B6, B7 & B9 components are complete. **FE Thermal Interlock Module (FETIM)** was a late emerging project requirement. CDMR passed in June 2012; production deliveries were complete in Q4 but some integration into kits testing remains before delivery to the OSF for retrofit into FEs. This is expected to complete in Q1 FY 2013.

## Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Back End**

- Decommissioning and delivery to OSF of an Antenna Article Test Stand [Q2]
  - The Antenna Article test stand is available for shipment as planned
- Deliver all documentation required by the Configuration Item Documentation Lists (CIDL) [Q4]
  - In progress; will be complete in Q1 FY2013

- **Correlator**

- Reassembly at the AOS of the Correlator fourth quadrant complete [Q2]
  - Migration to and testing of 4-quadrant configuration started on schedule 3 Sep
  - All hardware-based testing passed on schedule
  - Integration tests revealed two problems
    - One, related to phase jumps, was fixed by 30 Sep
    - A fix for the other, related to output data ordering, will be tested early Q1 FY 2013



Mauricio Pilleux/Mark McKinnon

**Back End:** Closeout of documentation handoff requirements are being managed and will be ready by Q1 FY 2013. Back End IPT has transitioned fully into operations support mode with 4.25 FTEs based in Socorro and 2 FTEs in Charlottesville.

**Correlator:** The integration of the all four quadrants commenced on schedule Sep. 3. All items in the Correlator PAS Test procedure passed.

## Observatory Telescope Operations - ALMA Construction Specific Milestones

- **Computing**
  - ALMA software release R9.0/R 9.1 [Q1, Q3]
    - 9.1.0 released to CSV for Phase V testing
- **Science IPT**
  - Continues work in ALMA CSV

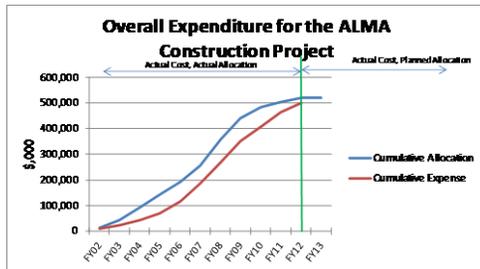


Mauricio Pilleux/Mark McKinnon

**Computing: Release 9.1.0**, which contains 4 quadrant support, was tested against the correlator hardware and released for CSV Phase V testing in September. It is expected to be formally accepted and used for Cycle 0 observing in October 2012.

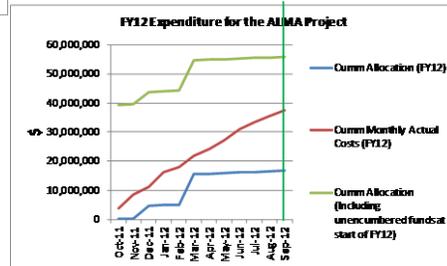
**Science:** Science IPT worked with the NA antenna contractor to test newly assembled antennas before delivery to JAO and provides help to resolve antenna problems uncovered by JAO.

## Observatory Telescope Operations ALMA Construction Financial Performance Graphs Overall & Q4 FY2012



Overall Spending for the ALMA Construction Project

FY12 Spending for the ALMA Construction Project



Mauricio Pilleux/Mark McKinnon

Both graphs show the **NSF budget allocation**. In the case of the overall plan, the cumulative allocation is the allocation actually provided by NSF through the end of the project.

## Observatory Telescope Operations

### - ALMA Construction Significant Events-Japan Partnership

- NA FE #20 shipped with integrated Band 4, Band 8 and Band 10 Cartridges
- NA FE #21 shipped with integrated Band 4 and Band 10 CCA
- NA FE#22 will ship with no NAOJ Cold Cartridges
- Four additional Band 4 WCAs completed during Q4
  - Total delivered: 64 of 80
- Four additional Band 8 WCAs delivered during Q4
  - Total delivered: 61 of 78
- One pre-production Band 10 WCA repaired in Q4
- 28 Band 10 multipliers delivered.



Mauricio Pilleux/Mark McKinnon

**Front End Assemblies:** Overall, NAOJ's 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 NAOJ's late entry into the project. Integration planning for Band 4, 8, and 10 CCAs is complete. Some work will occur at the NA FEIC and EA FEIC; the balance of this work will occur at the OSF. NA FEs #20 & 21 were shipped with integrated cartridges (cold + warm cartridge subassemblies) as indicated above. **Warm Cartridge Assemblies:** Production of Band 4 and Band 8 WCAs will be completed during Q1 FY2013. Production of Band 10 WCAs will complete in Q2 FY2013.

## Observatory Telescope Operations - Office of Chile Affairs (OCA) Significant Events

### • Staffing

- International staff supported by the OCA at the end of Q4: 21
- ALMA local staff
  - 12 new hires in the period, for a total of 300 LSM (25 are AUI/NRAO staff)
- Coordination with JAO HR management
  - New card-swipe time & attendance system procedures were agreed with JAO. Implementation of the system was successful
- OCA HR Manager in process of being hired

### • Activities

- Purchase Orders processed:
  - 20 (\$105k) for ALMA Construction
  - 81 (\$1,038k) for JAO Operations
- Catering, cleaning and minor maintenance contracts were re-bid by instruction of the JAO due to price changes in current Sodexo contract
  - Process will finalize in October 2012



Mauricio Pilleux/Mark McKinnon

Office of Chile Affairs (OCA): The number of **international staff** at the end of Q4 is 21 FTE. OCA has increased the total number of **Local Staff Members** employed in the quarter, bringing the total number of employees for which OCA provides ALMA with legal, payroll and travel support to 300 local staff on 30 September 2012 (25 are under AUI/NRAO direct supervision).

OCA has provided the legal and institutional support for contracts and procurements for ALMA as follows: a total of 20 purchase orders were issued for ALMA Construction (\$105k) and 81 for JAO Operations (\$1,038k). Reports were issued to CONAMA (environmental authority) related to flora/fauna and archaeological follow-ups. A request to CONAMA was submitted to move from monthly to quarterly biological monitoring.

Catering, cleaning and minor maintenance contracts were re-bid by instruction of the JAO due to price changes forced by Sodexo in its current contract. JAO issued new statement of work. Bid process will finalize in October 2012.

## ALMA Operations

- **Operations**

- Proposal deadline for ALMA Cycle 1 observing was July 12
  - Observations to begin on January 1, 2013; End on October 31, 2013
  - 1133 unique proposals; 2835 individual proposers
    - Oversubscription factor = 5
- Search for NRAO AD of ALMA-NA Operations is complete (P. Jewell)
- Review of JAO Operations budget held on Sep 24-25
  - JAO budget for 2013 appears plausible
  - Projected cost of power in 2014+ does not fit within projected budget
  - Partnership needs to develop and quantify range of actions to address budget shortfall, and increase operations planning capacity

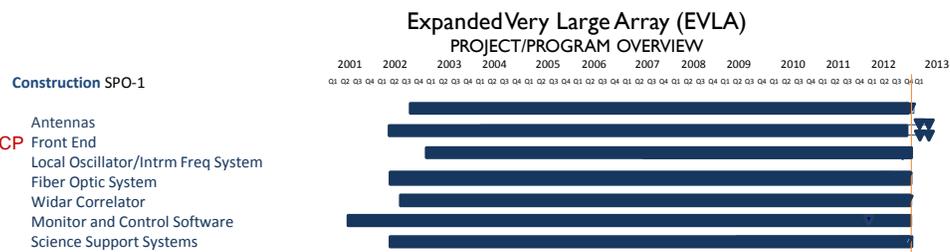
- **Maintenance Plans and Schedules**

- Multiple training sessions held in both NA (HIA, Socorro, NTC) and Chile for JAO technical staff



Mauricio Pilleux/Mark McKinnon

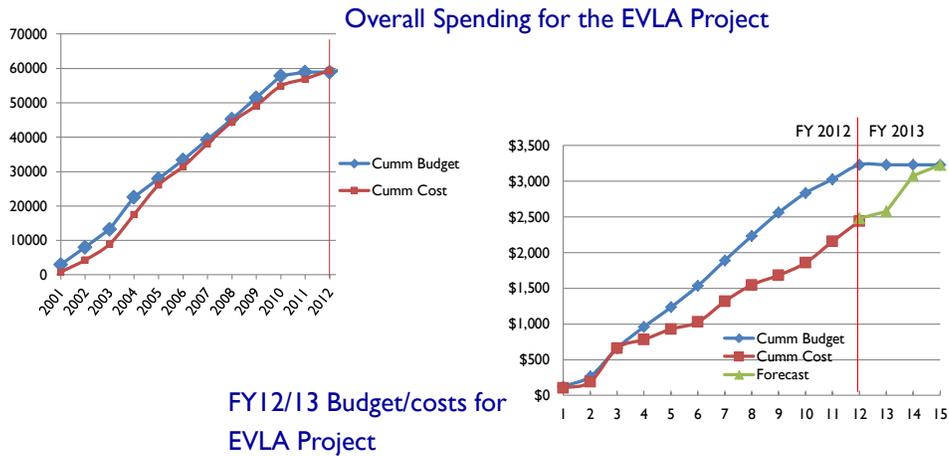
# Observatory Telescope Operations - EVLA Construction



D. Frail w/ input from Langley

The top graph reports status on POP goals for the current fiscal year. The bottom graph illustrates the full lifecycle of the EVLA construction project. The vertical line represents where we are today. The CP represents the critical path. FE receiver production remains on the critical path, as the final receiver deliveries are not scheduled until the end of the current calendar year. Details are provided in additional slides.

## Observatory Telescope Operations - EVLA Construction Financial Performance Graphs



D. Frail w/ input from Langley

The final EVLA construction tasks are scheduled to be completed in FY2013 Q1, with no cost extension. The plots on this slide represent the overall project spending profile as well as the FY2012 spending along with the FY2013 extension.

The budget line (blue) is based on a linear progression of the total budget for the fiscal year., the cost line (red) represents the actual expenditures to date, and the forecast line (green) represents the anticipated expenditures based on spending plans. Major budgeted expenditures will take place in Q1. These include the archive hardware and computing cluster (~\$516k). Computing had delayed spending these funds for as long as possible so as to receive the highest level of hardware for the dollar. Other major upcoming expenditures include the overall effort to develop an Antenna Control Unit prototype (~\$100k remaining) . The EVLA management account currently holds a balance of ~\$111k. These funds are to be used for EVLA staff layoff severance packages and the occasional small purchases which arise during Q1. Any remaining funds from the management account will be reassigned to contingency.

As of the end of Q4, the contingency balance stood at \$500K with no risks remaining to the construction project, the last of which having been retired during Q4. These left over funds, subject to NSF approval, are being considered for operational projects which have arisen as a direct result of the VLA upgrade. Recommendations are documented in the *Remaining Funds Management Plan*, which has been submitted to the NRAO Director.

## Observatory Telescope Operations - EVLA Construction

- **Antennas**
  - 4<sup>th</sup> cryogenic system installation on all antennas will be completed FY2013 Q1
- **Local Oscillator / Intermediate Frequency Subsystem**
  - 3-bit mode compliant downconverters fully deployed
- **Front End Receiver Bands**
  - L-band receiver installation complete
  - S-band receiver installation to be completed FY2013 Q1
  - X-band receiver installation to be completed FY 2013 Q1
  - 26 Ku-band receivers built, full installation to be completed FY2013 Q1



D. Frail w/ input from Langley

The 4<sup>th</sup> cryogenic system for each antenna were scheduled to be completed by September 30. These systems are installed to coincide with the full complement of FE receiver installations, which are also not yet completed. The cryogenic system installations are now scheduled to be completed in Q1. At present, 24 cryogenic systems are complete, and the remaining are in various stages of completion. No special mitigation is needed to assure completion of the cryogenic systems.

All L-band, 26 S-band, 24 X-band, and 25 Ku-band receivers have been installed. S- and Ku- band receivers are in good shape to be completed by the end of the 2012 calendar year. Since the X-band effort was the most affected by the recent RIF, manpower resources are being diverted from the other bands to facilitate schedule catch-up.

## Observatory Telescope Operations - *EVLA Construction*

- **Fiber Optic**
  - 3-bit sampler installation completed
- **Correlator**
  - Significant software changes to support new observing modes
  - Massively reworked correlator testing software, to allow for engineers to test correlator hardware on a weekly basis
  - New firmware for control of 3-bit, more complex WIDAR setups, phased-array
  - EVLA project formally accepted the WIDAR correlator from HIA-NRC on September 28



D. Frail w/ input from Langley

## Observatory Telescope Operations

### - EVLA Construction

- **Monitor and Control**
  - Software updated to allow for special correlator modes, including autocorrelations, pulsar binning, phasing, burst mode, and many other features
  - Operators control software release v2.4.4
- **Science Support Systems**
  - All SSS milestones are covered by Observatory Science Operations



D. Frail w/ input from Langley

## Observatory Telescope Operations - EVLA Construction

- **Management**
  - Most construction accounts closed
  - Construction staff reductions complete
  - Remaining EVLA funds management plan submitted to Director
  - All risks retired
- **Overall Project Completion**
  - EVLA Construction hardware tasks will be completed during FY2013 Q1



D. Frail w/ input from Chandler

## Observatory Telescope Operations - EVLA Commissioning

- **Commissioning milestones for Q4**

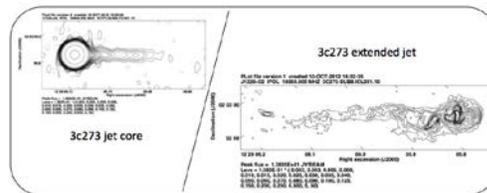
- **Phased array observing:**

- Completion delayed to Q1 FY13. Significant progress made in Q4 but some work still remains before the mode can be offered to users
    - Figure shows 3C273 in C-band continuum observed with the phased VLA and VLBA. The image was reduced and imaged in a standard way with AIPS software



- **3-bit samplers commissioning complete for RSRO:**

- Figure shows 3C273 in K-band continuum observed with the 3-bit sampler system. The image dynamic range is 250,000:1



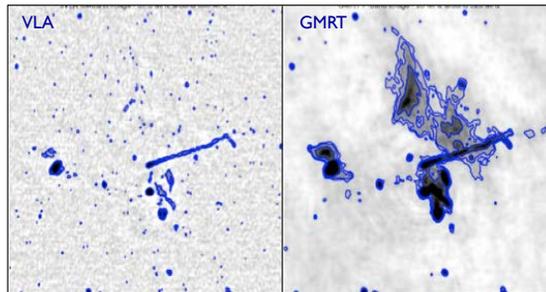
D. Frail

**Phased array observing commissioned:** Q3 saw the ability to phase the VLA in a single observing mode and record the data (but not correlate it with the VLBA) and obtain fringes between a single VLA antenna and the VLBA. In Q4, fringes can now be reliably obtained between the phased VLA (all 27 antennas) and the VLBA and images can be obtained (see above). Some work is still required before it is ready for users, mostly in the setting up of the VLA using the VLBA's SCHED software and in testing the full range of compatibility modes between the phased VLA and the VLBA.

**3-bit samplers commissioned for RSRO observing:** The 3-bit samplers can now be used by RSROs in a standard way. Scheduling blocks can be generated in the test version of the OPT, and dynamically scheduled in the standard way. The 3-bit sampler bandpass stability is very good, showing day-to-day variability of 0.1%. Current RSRO and EVLA Commissioning Staff Observing programs are being used to evaluate imaging quality, accuracy of the flux density scale as a function of elevation, and appropriate data weighting schemes in CASA. The commissioning effort will continue into FY2013 Q1, focusing on improving robustness in preparation for the upcoming D-configuration and Full Operations.

## Observatory Telescope Operations - EVLA Commissioning

- **Commissioning milestones for Q4**
  - **First shared risk observations with low-band system:**
    - *Figure shows one of the first VLA P-band observations of the Galaxy cluster Abel 2256, obtained September 2012*



D. Frail

**First shared risk observations with low-band system:** The first science observations with the Low-band system were made on 13 & 14 September 2012 in the BnA configuration. Ten antennas were outfitted with working P-band receivers at that time. The VLA sensitivity achieved was about 0.5 mJy/beam (using ~30% of the bandwidth at P-band to avoid RFI in a three hour observation). Comparison with deep images made with the GMRT shows good agreement with the compact features (see figure). Large-scale emission is not detectable with the VLA due to lack of short baselines in this single observation.

## Observatory Telescope Operations - Jansky VLA Operations

- **Railroad infrastructure maintenance and repair**
  - Rebuilt three intersections and four sets of concrete timbers
- **Antennas**
  - Overhauls completed on antennas 2, 10
- **Array reconfiguration**
  - Move from B to BnA configuration completed
- **RFI mitigation**
  - Designed and executed a propagation test from the apex of an EVLA antenna



D. Frail w/ input from P. Perley

**Railroad Infrastructure maintenance and repair:** Three intersections were rebuilt, at pads AN-8, BN-9, and AW-5; four set of concrete timbers were built and poured; both tracks were leveled and lined from HWY 60 to DN-4; the track was plowed, broomed, and ballast was added; rail Inspection was completed on North, West and East arms.

**Antennas:** Overhauls were completed on antennas 2 and 10, including an azimuth bearing change on antenna 10. Water leaks were identified in X-band receiver windows, and improved rings designed.

**Array Reconfiguration:** The move from B to BnA configuration was completed, and the move from BnA to A began on September 24, on schedule, and was completed on October 2.

**RFI mitigation:** A propagation test was designed and executed from the apex of an EVLA antenna. The propagation loss results will be used to analyze the effects of any RF emissions detected from the new FRM motor control systems. An additional EVLA X-band feedhorn was tested for return-loss, as were the last 3 VLBA C-band feedhorns. The new LWA correlator was tested for RF emissions, in collaboration with J. Kocz of MIT-CfA, to ensure minimal impact on the VLA.

## Observatory Telescope Operations - Jansky VLA Operations

- **Other activities**

- Numerous electrical repairs and upgrades
- Work on VLA Control Building infrastructure
- Designed, located and installed power and fiber for the API Upgrade



D. Frail w/ input from P. Perley

### Other Activities:

Various electrical repairs and upgrades were performed during Q4:

- Replaced 75 kVA transformer at W12
- Performed analysis on and replaced fuses with more suitable values at BW9 switch (Improved fusing on West Arm)
- Repaired lighting damage to west arm high voltage distribution
- Prototyped and tested improved three-phase power monitor to help cryogenics run through power glitches

Prepared ground for Sundial, hosted W. Sullivan for the purpose of finalizing the design.

VLA Control Building Infrastructure:

- Repaired EMCC I motor control center and improved operational strategies for VLA Control Building chiller; repaired oil separator and piping for chiller
- Ordered all supplies for D-rack room retrofit

Designed, located, and installed power and fiber for Atmospheric Phase Interferometer (API) upgrade.

## Observatory Telescope Operations - Jansky VLA Low-Band Receiver Project

- **Milestones**

- At the end of FY2012 Q4 there were 16 low band systems installed in the array
- The project is on schedule for completion during FY2014 Q1, to be ready for the A-configuration in FY2014 Q2
- System performance is very good
  - P-Band has a T-system of about 99K
  - 4 band has a T-system of about 2085K

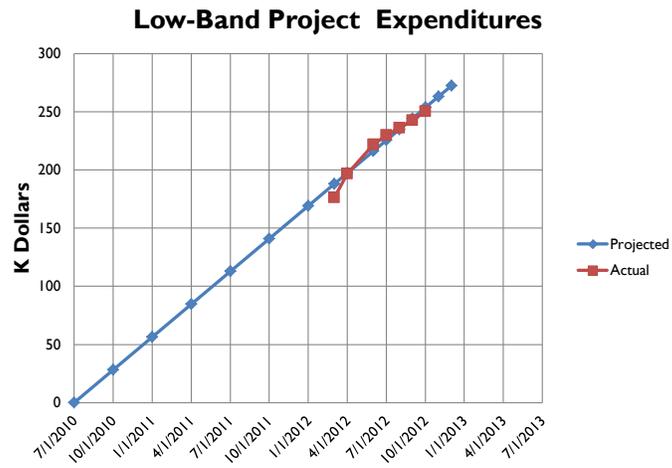


D. Frail w/ input from P. Perley

At the end of FY2012 Q4 there were 16 low band systems installed in the array. The Project is on schedule to be completed in time for the next A-configuration, scheduled to begin January 2014.

The performance of the new system has been very good. P-Band has a T-system of 99K and 4 band has a T-system of about 2085K.

# Observatory Telescope Operations - JVLA Low Band Project Financial Performance



D. Frail w/ input from Durand

## Observatory Telescope Operations - VLBA Operations

- **Infrastructure maintenance and repair**
  - Tiger team visit to Los Alamos
- **RFI mitigation**
  - Investigations into Brewster C-band RFI on-going
- **Daily UTI-UTC observations for USNO**
  - Daily observations begun (Pie Town and Mauna Kea)
- **Other operations activities**
  - Los Alamos maser replaced



D. Frail w/ input from Perley/Briskin

**Infrastructure maintenance and repair:** There was a Tiger Team visit to LA in Q4. **RFI mitigation:** Investigations into the Brewster C-band RFI continue – it is likely to be a microwave link site (Lake Patros to Chelan Butte), we are awaiting response from nearby satellite earth station to see if the cause is the Brewster USE1-Teleport. In July 2012 we coordinated with lunar rover tests at "Apollo Valley" on Mauna Kea, and minimized the impact to VLBA observing.

**Daily UTI-UTC observations for USNO:** The daily UTI-UTC observations using PT and MK began in Q4.

**Other operations activities:** The maser at LA may need new physics package. This maser is usable but needs to be adjusted by hand, so is not appropriate for use at a remote site. The last spare was swapped into LA. We are investigating opportunities for acquiring additional masers or suitable substitutes in FY2013.

## Observatory Telescope Operations - VLBA Sensitivity Upgrade and Commissioning

- **Second digital backend installed at all sites**
  - Installation has been completed at 7 sites
  - The Xcube Ethernet switch has been installed at LA
  - Commissioning of this hardware will be completed by FY2013 Q3, following installation of the Xcube switches
- **Digital Backend Commissioning**
  - Digital Down-Converter personality not yet fully commissioned; problems with aliasing and delay jumps were fixed during Q4
    - Risk is low, users can use legacy system for spectroscopy; no mitigation needed

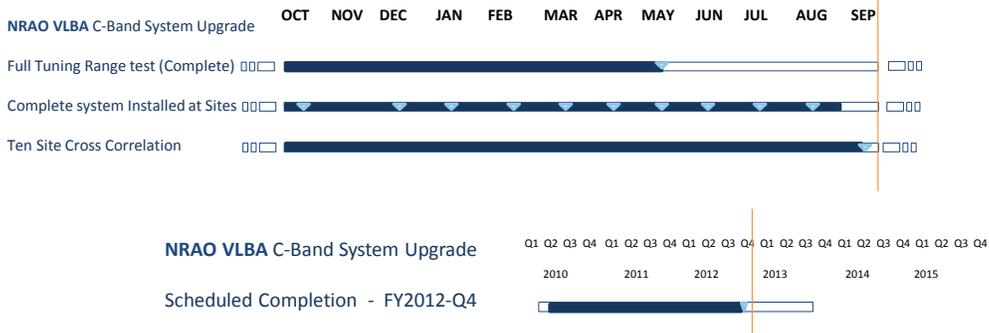


D. Frail w/ input from J. Romney

**Second digital backend:** The second digital back end and Xcube Ethernet switch is required to provide observers with 8 DDC passbands. The 8 passbands will be recorded on a single Mark 5C. Maximum data rate is 2Giga bits/s.

**Digital Backend Commissioning:** The DDC FPGA personality will support both wideband observations and narrower spectroscopic observing modes in the VLBA's digital backend, with flexible tuning and advanced calibration capabilities. Aliased out-of-band signals occurring in earlier firmware versions have now been eliminated, as has a problem that resulted in delay jumps at scan transitions. A new test on October 9 is awaiting correlation, and will hopefully demonstrate that all issues are now resolved, leading to an immediate science demonstration. The Polyphase Filter Bank (PFB) FPGA personality can already support wideband continuum observations at 2 Gbps, and the legacy backend remains available for narrowband spectroscopy. The risk associated with the delay in the DDC is therefore low for users, and mostly lies in the potential for the legacy system to fail in the near future due to aging components.

## Observatory Telescope Operations - VLBA Upgrades: C-Band Receiver System FY2012-Q4



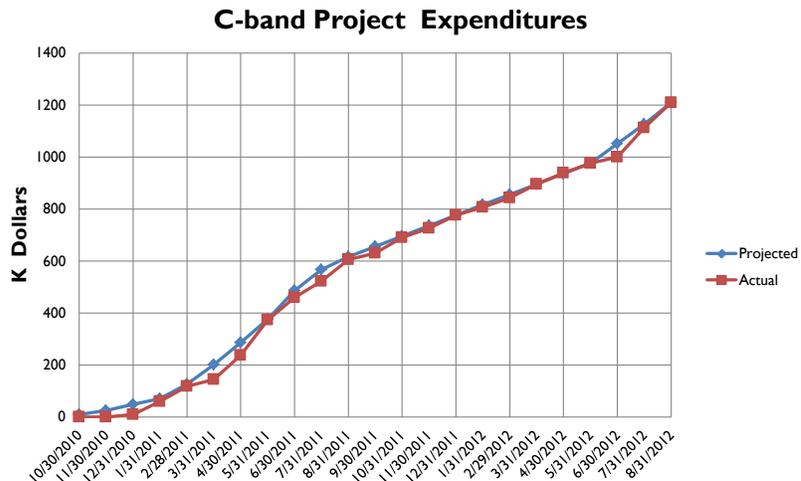
Claire Chandler w/ input from S. Durand

MK, SC, and LA were outfitted with complete C-band systems during Q4, meeting the goal of 10 complete systems. A ten-site cross correlation was also completed in September. The project was completed in FY2012-Q4, on schedule and on budget.

VLBA C-Band Project Support: GB Machine Shop has fabricated the required C-Band Feeds. The VLA Machine shop has completed fabricating the projects worth of dewars, OMTs, and module chassis. CDL provided the LNAs.

The C-band system upgrade relied on many new NRAO techniques. A new thermal gap was designed which lowered the receiver temperature in the 4 - 6GHz region. The EVLA Ortho Mode Transducer (OMT) was modified to reduce the cooling mass, and a four channel down converter was developed using EVLA techniques. These technical advances produced a receiver system that has high sensitivity (receiver temperature of less than 9K).

## Observatory Telescope Operations FY2012-Q4 - VLBA C-Band Project Financial Performance



Dale Frail w/ input from Durand

The C-band Project completed the installation of the receivers, downconverters and new monitor and control equipment at all 10 VLBA sites, September 2012. A new synthesizer is needed to support the wide tuning ranges of the C-band receiver, and the bandwidths now available with the 2 Gbps system. Development began in FY2012 Q1, and a functional prototype will be completed in FY 2013.

As of FY2012 Q4 the project has spent the project budget (\$1209k) and the project is closed and completed. Procurement of some of the major parts to build the 20 Synthesizers has also been completed.

## Observatory Telescope Operations - *New Mexico Operations*

- **Projects (Work for Others)**
  - **USNO DiFX correlator Phase I**
    - Correlator delivered and functional September 26<sup>th</sup>
    - Acceptance schedule for mid-November
    - Computing Infrastructure contracted for support through FY13
  - **Shanghai C-band Receiver Project**
    - On schedule to ship in April 2013
  - **Onsala Space Observatory C-Band OMT and Thermal Gap**
    - On schedule to ship November 2012 (Q1)



D. Frail

**USNO DiFX correlator:** The DiFX correlator was delivered and made functional on September 26<sup>th</sup>. Final acceptance is expected in mid-November during a visit to USNO by Walter Brisken, Dale Frail and Tony Beasley. We are contracted for support through FY2013, negotiations are underway for a small expansion to Phase I and the optional Phase II. Phase II comprises a doubling in capability of the Phase I correlator and extended support through 2016.

**Shanghai C-band Receiver Project:** On schedule to ship in April 2013.

**Onsala Space Observatory C-Band OMT and Thermal Gap:** On schedule to ship November 2012 (FY2013 Q1).

## Observatory Telescope Operations - Green Bank Operations

- **GBT Subreflector**
  - Two rebuilt subreflector actuators were replaced during Q4 FY2012.
  - Four remain to be replaced
  - Replacement paced by deliveries from manufacturer.
- **A good year of structural painting**
- **Structural inspections completed**
  - The aggressive painting schedule is working
  - Minor weld cracks repaired
- **Cleanup from Derecho in Green Bank completed**



K. O'Neil w/ input from Holstine/Bloss

Telescope Operations replaced two **subreflector actuators** with units that had completed the refurbish and upgrade process, leaving four more to be completed in Q1 & Q2 FY2013. The replacement schedule is dependent on the speed at which the manufacturer can perform the refurbishment and upgrades on actuators removed from service and routed through refurbishment.

The end of FY2013 represents another good year of **painting effort**. A combination of an excellent work crew with many repeating workers bringing valuable repeat experience and good weather contributed to the success.

Engineering contractors Modjeski and Masters completed the regular **structural inspection of the telescope** this summer. The inspection is conducted every three years. Their overall impression was that the telescope was in good shape, and that our increased emphasis on painting is paying off. Weld cracks found at the receiver room connections and were repaired and re-inspected satisfactorily.

Cleanup of debris and damage to roads, paths and trails from the Derecho storm is completed.

## Observatory Telescope Operations - Green Bank Operations

- **Facility Upgrade Projects:**
  - **Replacement GBT S/W Libraries**
    - Testing with the GBT systems throughout Q4 FY2012
    - Completed regression testing
    - Final release in Q1 FY2013
  - **Installation of Multi-color Tipper**
    - Phase #1 mitigation completed
  - **Carry Forward Projects**
    - GBT Servo Replacement Project – Regrouping after staff RIF



K. O'Neil w/ input from Holstine/Bloss

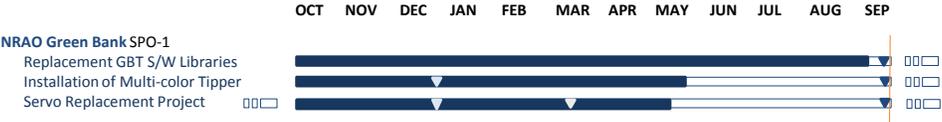
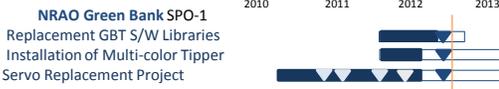
*Replacement GBT S/W Libraries* – In Q4 FY2012, the Software Division built and exhaustively tested all GBT software with 64-bit Red Hat v6. Planning final release for Q1 FY2013. Risk: None. All observing services are being maintained.

*Installation of Multi-color Tipper* – The first phase of the RFI mitigation is complete. Components mitigated: Rain Sensor Board, RH & Humidity Sensor, Superblower controller, and Power Supply. Risk: Delayed deployment means less data may be available for characterizing the Green Bank atmosphere; Mitigation: Establish initial parameters with less data or extend data collection time in FY2013.

*Carry Forward Projects: GBT Servo Replacement Project* – Work was slowed considerably when the lead control kernel engineer was lost in the Observatory-wide RIF. Two other digital engineers have been partially re-tasked from other Green Bank projects to pick up for the loss of the fulltime resource. The project is behind schedule. Risk: Delays in incorporating pointing improvements into the GBT servo for high-frequency spectral observations; Mitigation: Provide additional time for high-frequency projects and retain tighter high frequency weather parameters to schedule projects.

# Observatory Telescope Operations

## - Green Bank Telescope Upgrades



NOTE: These development activities are unrelated, therefore there is no critical path identified.

K. O'Neil w/ input from Bloss

## Observatory Telescope Operations - Green Bank Operations

- **Projects**
  - **Baryon Acoustic Oscillations 800 MHz Multi-pixel receiver (ASIAA)**
    - NRAO work is suspended as collaboration issues are resolved
  - **PAPER**
    - Second production run of antennas and ground screens in process
  - **RadioAstron**
    - Services are excluded from ITAR requirements; resumed contract negotiations and technical discussions



K. O'Neil w/ input from Holstine/Bloss

*Baryon Acoustic Oscillations 800 MHz Multi-pixel receiver (ASIAA)* - NRAO work is suspended pending detailed project and responsibility discussions with Taiwanese partner.

*PAPER* – The second production run of antenna and ground screen fabrication is underway and steel frames for the balance of the project are complete. This is a lower priority project for the shop and the schedule remains flexible to accommodate the variability of resource.

*RadioAstron* – The Department of State has agreed that the project does not fall under ITAR jurisdiction and may proceed. Contract negotiations and technical discussions resumed in mid-August and a signed agreement is anticipated in early FY 2013.

## Agenda

- Science Results
- Observatory Science Operations
- Observatory Telescope Operations
- Observatory Development & Programs (ODP)
  - Coordinated Development Laboratory
  - CDL Production, Maintenance and Repair
  - New Initiatives Office
- Broader Impact
- Observatory Administrative Services
- Director's Office



## Observatory Development & Programs - Central Development Laboratory

- **Amplifier Development**

- Tested new cryo3 ALMA band 2 (65-90 GHz) amplifier
- Designs for ALMA bands 1 (33-50 GHz) amplifier complete.
- Continued research on general amplifier noise properties.
- Continued investigation of phased array feed noise properties.
- Designed 84-116 GHz MMIC LNA for third APRA 35nm wafer.



S. Pan and E. Bryerton w/ input from Pospieszalski

**Amplifier Development:** A demonstration **ALMA band 2 amplifier** using NGST cryo3 exhibited less than 30 K from 70 to 83 GHz and less than 50 K from 65 to 88 GHz with about 38 dB of gain. This design will be used for the GBT 4mm receiver. Electrical design of cryo3 **ALMA band 1 amplifier** is complete and will be tested next quarter. Research into **general amplifier noise properties**; in particular on noise properties of heterojunction bipolar transistors (HBTs) and CMOS MOSFET continues. An invited paper covering the design and performance of cryogenic amplifiers is to be presented IEEE RWW 2013 Conference, Austin, TX, Jan. 20-23, 2013.

Using test results from second APRA 35nm wafer to modify the device model, designed 84-116 GHz MMIC LNA for **third APRA 35nm wafer**.

## Observatory Development & Programs - Central Development Laboratory

- **Electromagnetic Development**
  - Completed feed horn for GBT 11-18 GHz pulsar receiver.
  - Reoptimized design of ALMA band 1 (33-50 GHz) orthomode transducer.
  - Started design of 4-8 GHz feed for Shanghai 65m telescope.
- **Advanced Receiver Development**
  - S-Band (2-4 GHz) SiGe LNA performance verified.
  - Real-Time Spectrometer demonstrated with four channels.



S. Pan and E. Bryerton w/ input from Srikanth/Morgan

**Electromagnetic Development:** Completed testing of broadband corrugated horn for the **GBT 11-18 GHz pulsar receiver**. Patterns for the Ku-band feed were measured between 10.4 and 19 GHz. The measured patterns show good circular symmetry. The average illumination taper at 15° is -13.2 dB in the H-plane and -13.4 dB in the E-plane. Cross-polarization measured in the diagonal plane is  $\leq -28.8$  dB. Measured return loss is 18.3 dB at 10 GHz and better than 20 dB above 10.1 GHz. The simulated return loss of the **ALMA band 1 OMT** scaled from an Ku-band design is  $\geq 18.5$  dB from 35 to 50 GHz. The OMT was optimized further and return loss is  $\geq 23$  dB in the 35-50 GHz band. This OMT measures 3.0"x4.1".

**Advanced Receiver Development:** The **S-Band (2-4 GHz) SiGe LNA** which was sent to Caltech was successfully verified in their test set, showing 2.3K minimum noise temperature, compared to 6K measured at the NTC. Following this result, extensive tests were done at both sites to verify the independent calibrations. Although some uncertainty remains, it was concluded that Caltech's measurements were reading approximately 1K low, while NTC's were reading 1-2K high. The amplifier in question is believed to perform at approximately the 3.5K level, which is comparable to the best results achieved in this band, but not record-breaking. Work continues to resolve some mechanical issues related to the module layout.

For the first time in the Advanced Receiver Development project, we were able to stream full frequency spectra in 4 channels using a **real-time spectrometer**. While these were only raw power spectra, without sideband or polarization separation, it represents an overwhelming majority of the computing power required for the ultimate application of the Advanced Integrated Receiver, and the path toward fully-calibrated, dual-sideband, dual-polarization operation is now clear. This is a vast improvement over the previous mode of operation in which we had been stuck for the past 3 years, wherein short, sub-second bursts of data were captured and post-processed in software, sometimes over several days, before a complete set of spectra could finally be reviewed in detail.

## Observatory Development & Programs - Central Development Laboratory

- **Millimeter & Submillimeter-Wave Receiver Development**
  - Assembling 385-500 GHz balanced mixer using waveguide hybrid.
  - Next generation ALMA Band 6 balanced mixer prototype ready for testing.
  - Continuing optimization of AlN tunnel barriers for SIS junctions.
  - NbTiN deposition under development.



S. Pan and E. Bryerton w/ input from Kerr/Lichtenberger

**Millimeter & Submillimeter-Wave Receiver Development: 385-500 GHz balanced mixers** using Nb/Al-AlN/Nb trilayer have been measured and show 2-3 dB higher loss than single-ended mixers built using same component mixer chips. Single-ended mixers give 60-70K DSB noise temperature over the 385-500 GHz band. The excess noise of the balanced mixers may be due to the membrane hybrids, which are being tested in this design for possible scaling to THz frequencies where conventional waveguide hybrids are impractical. To resolve this, 385-500 GHz balanced SIS mixers with *waveguide hybrids* have been completed in the CDL shop and are now having mixer chips installed.

**ALMA Band 6v2 (211-275 GHz) balanced SIS mixers**, based on the successful single-ended Band-6 design, are ready for testing when the feed horn is completed by the CDL shop and electroforming lab. The shop has completed the required LO attenuator and square-to-rectangular waveguide adapter.

**Continuing optimization of AlN tunnel barriers for SIS junctions:** AlN tunnel barriers are needed for all the planned SIS mixers. Optimization of AlN tunnel barrier growth continues with the goal of producing junctions with very low leakage current and highly reproducible barriers. A wafer with optimized AlN barrier thickness, currently in process, is expected to yield single-ended mixers for 385-500 GHz with substantially reduced loss. The 385-500 GHz mixer designs serve as proof-of-concept for band 10 (787-950 GHz) and band 11 (>1 THz) SIS mixers.

The **NbTiN deposition** process needed to produce Nb/Al- AlN/NbTiN trilayer for ALMA Band 10 and 11 mixers is under development.

## Observatory Development & Programs - Central Development Laboratory

- **Phased Array Feed**

- Continued installation of optical fiber links .
- Continued testing of software and GUI for GBT control of PAF.
- BYU began testing FPGA-based signal processing system.
- BYU manufactured new dipoles for wider-spaced array.
- Continued electromagnetic modeling of PAF noise properties.



S. Pan and E. Bryerton w/ input from Fisher

**Phased Array Feed:** The move to the new receiver configuration with L-band **optical fiber links** from the front-end to the receiver electronics in the lab is progressing as technician time is available. Throughout FY12 the engineering and technician time available has been one third to one half of the allocations so progress has been slower than planned. On the positive side, BYU grad students have made unexpectedly good progress toward an **FPGA-based signal processing system** for the PAF and we are planning for the possibility that it can be used for the first tests of the PAF on the GBT. For the next generation PAF, optimized for the GBT, BYU has manufactured the **new dipoles for wider-spaced array**. **Electromagnetic modeling of PAF noise properties** continues, progressing toward a comprehensive parametric model. To improve modeling, the dipoles were measured on the outdoor antenna range for comparison with simulations.

## Observatory Development & Programs - Central Development Laboratory

- **The Precision Array to Probe the Epoch of Reionization (PAPER)** (collaboration with UC Berkeley) Continued construction of 128-element South African Array.
  - Continued observations using South African 64-element array.
  - Continued experiments using Green Bank 32-element array.
- **LUNAR**
  - Continued to develop NASA Dark Ages Radio Explorer (DARE) mission proposal.
  - Continued to work on DARE Instrumentation Verification Plan.



S. Pan and E. Bryerton w/ input from Bradley

**The Precision Array to Probe the Epoch of Reionization (PAPER):** Construction and testing of components for the expanded **128-element South African Array** continued this quarter. Data analysis and observations continue using the existing **South African 64-element** and **Green Bank 32-element** 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. Continued to work on the **DARE Instrument Verification Plan**, including continued long-term observations with the engineering prototype in Australia this quarter.

## Observatory Development & Programs - CDL Production, Maintenance and Repair

- **HFET Amplifier Production**

- Delivered 11 new amplifiers to VLA.
- Delivered six 4-8 GHz amplifiers to VLBA and other projects.
- Delivered two 65-90 GHz amplifiers to GBT.
- Repaired and retested 14 amplifiers for the VLA , GBT, and VLBA.



S. Pan and E. Bryerton w/ input from Pospieszalski

**HFET Amplifier Production:** New amplifier production included six 4-8 GHz, four 8 -12 GHz, seven 12-18 GHz and two 65-90 GHz amplifiers. Repair, upgrade, and retesting of amplifiers included nine 1-2 GHz, two 8-12 GHz, and three 8-18 GHz. In total, 33 amplifiers were shipped. The EVLA and VLBA amplifier production is slightly behind schedule (only affecting spares) due to competing priorities. The schedule is expected to be made up without impact to the planned construction project end date for EVLA.

## Observatory Development & Programs - ALMA Development Projects

- **Development Projects** (ALMA Board approved)
  - Band 5 receiver production: EU/NA coordination meeting held on Sep 13 to agree way forward on incorporating new LO components in CCA and method for qualifying full LO chain.
  - OSF-Calama optical fiber
    - NSF approved contract award. Cost within cap of \$1.9M
    - Operations costs much lower than predicted
- **Development proposals in process**
  - Project plan for Phasing ALMA as part of mm-VLBI submitted to ADSC by NA Executive for ALMA Board approval
  - Project plan for full production of Band 1 receivers submitted by EA Executive to ADSC
  - Development proposal written for support of NA SIS foundry



Development Studies: all under contract

Mauricio Pilleux/Mark McKinnon

## Observatory Development & Programs - GBT Development Projects

- **VEGAS Spectrometer (CICADA)**
  - Key spectrometer mode development at UC Berkeley
  - Delays in receiving FPGA cards
- **4mm Receiver**
  - Baseline performance analysis complete
    - Additional evaluation in lab in Q4FY2012
  - Amplifiers due early in Q1FY 2013
- **Prototype Feed for NANOGrav receiver**
  - Project work suspended after losing FY 2013 approval
- **12-18 GHz Broadband Pulsar Receiver**
  - Final assembly is underway



K. O'Neil w/ input from Bloss

*CICADA (VEGAS Spectrometer)* – Delivery of the ROACH 2 FPGA cards is now several months behind, but first run cards are now being evaluated by the manufacturer. Development activities of the multi spectral window modes at collaboration partner UC-Berkeley is also taking longer than planned, however there is full confidence that the work will be completed within the window of the ATI grant which funds the project. RISK: Full operations with VEGAS will be delayed beyond target completion. MITIGATION: The current spectrometer will continue be used for observations in the interim and scheduling observations requiring the advanced VEGAS capabilities will be delayed.

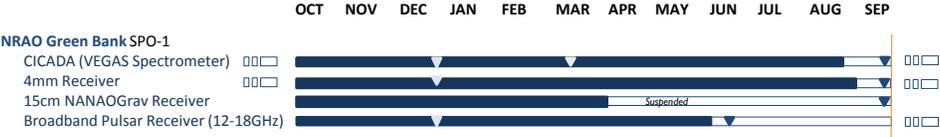
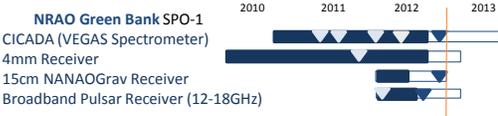
*4mm Receiver* – All of the scheduled tests planned for over the summer were conducted, but they were delayed by unrelated work on the lab spectrometer and securing the replacement amplifiers from CDL. RISK: Potentially missing the early part of high frequency observing season. MITIGATION: Reallocation of work to increase 4mm progress and delivery of amplifiers should accelerate completion in time for HF observing.

*15cm NANOGrav Receiver* – The proposal for mid-level R&D as a carried forward project into FY2013 was rejected. There was no activity on this project.

*Broadband Pulsar Receiver* – Once the issues with the internal design were resolved with the addition of a single broadband progress has moved rapidly. First light is anticipated in Q1FY 2014 immediately followed by commissioning and launch of campaign-mode pulsar search observations.

# Observatory Development & Programs

## - Green Bank Telescope Development Projects



NOTE: These development activities are unrelated, therefore there is no critical path identified.

K. O'Neil w/ input from Bloss

## Observatory Development & Programs - *New Initiatives*

- **LSST**
  - No new issues
- **Space Very Long Baseline Interferometry**
  - RadioAstron
    - Spacecraft continuing to operate well
    - Visit of Y. Kovalev and A. Smirnov to GB in September 2012 to discuss and finalize GB tracking station technical details and SOW (See “GB – Status of External Operations Support,” this QSU, and “Export Control,” below)
  - Discussions with SHAO *et al.* at Beijing IAU in re possible future Millimeter Wave VLBI satellite mission



R. Dickman.

LSST: F2F Meetings October 10, 11, 2012

SOW: Statement of Work for GB 140 tracking station contract

## Observatory Development & Programs

### - New Initiatives

- **Export Control**
  - ITAR Assessment program draft completed Q4 and under consideration by AUI
  - Impact of DDTC/DOS Advisory Opinions (AOs)
    - AUI/NRAO legal strategy in place
    - Commodity Jurisdiction (CJ) requests to DDTC/DOS
      - ALMA Front Ends: submitted, now cleared
      - SHAO C-band Receiver: submitted, now cleared
      - RadioAstron tracking station: submitted, now cleared for downlink
      - RadioAstron tracking station: Case for Maser timing uplink contingency capability drafted; at request of AUI, case is awaiting RadioAstron contract completion for consideration/discussion



R. Dickman

### Commodity Jurisdiction Request Dates and Status:

- ALMA Front Ends: CJ request submitted 5/18/12; clearance received 6/15
- SHAO C-band receiver: CJ request submitted 6/21/12; clearance received 7/30
- RadioAstron tracking station: CJ submitted 7/19/12; clearance received 8/24 (downlink functions only)

## Observatory Development & Programs

### - New Initiatives

- **GB – Status of External Operations Support:**
  - Draft contract and SOW completed for use of 43m antenna as data downlink station for RadioAstron satellite
    - Under final review
    - Initial contract for 2.5 years @\$2M/yr
    - Extensions planned subject to continued health of spacecraft and value of science mission
  - Internal NRAO ITAR assessment of full timing uplink function completed
    - Implementation recommended; will be sent to AUI for review with legal counsel in Q1 FY2013
- **NAA Workshop Organization:**
  - SOC organization and membership completed (J. Lazio Chair)
  - Meeting planning continuing



R. Dickman

### Timing Uplink:

The RadioAstron satellite has 2 on-board precision hydrogen maser oscillators. Their timing signals are used to stabilize the on-board radio astronomy receivers.

However, should both masers fail, the scientific mission of the satellite would not be sustainable without another precision timing standard. This is the role of the uplink channel: The carrier wave from Green Bank's maser clock would be sent to the RadioAstron satellite in place of the on-board maser output and would be used to derive the frequency stability references required for the on-board radio astronomy receivers. The GB maser signals would also be returned to the GB ground station in the 8.4 GHz downlink channel (without processing) in order to validate the frequency stability lock.

This uplink will be used only as a backup in the case of a failure of the on-board masers. Nonetheless, an early end-to-end test of this alternative stabilization process for the radio astronomy data stream is obviously desirable in order to validate the design and operation of the subsystem.

## Agenda

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



## Broader Impacts

### - Education & Public Outreach

- **External Press/Media Activity + Web Content Activity**

- ALMA broadcast documentary uplinked to PBS stations nationwide. Gets good review.
- Press release on ALMA and Astrochemistry, with accompanying video, released and makes it to the NSF home page
- Web-only release on Senator Udall's visit to the VLA.
- Web- and WV-only release on storm response award for Green Bank
- Handled media inquiry from Discover magazine
- Hosted filming visit to VLA from squeegee.com (children's "clean" video site)
- Hosted meeting of DC Association of Science Writers at Green Bank

- **Social Networking Activity**

- TheNRAO Twitter account up 11% from Q3
- ALMANRAO Twitter account up 19% from Q3
- Facebook up to 6,257 fans (13% increase from Q3), with 56 new posts this quarter, plus events listings.



J. Stoke

**ALMA documentary review:** <http://p3publicmedia.com/2012/09/06/into-deep-space-a-program-your-audience-can-get-into/>

**Astrochemistry release & video:** <http://www.nrao.edu/pr/2012/widespectra/>.

**Senator Udall release:** <http://www.nrao.edu/pr/2012/udallvisit/>.

**Award for GB release:** <http://www.nrao.edu/pr/2012/gbstorm/>

## Broader Impacts

### - Education & Public Outreach (continued)

- **STEM Education Activity**

- Multiple VLA group guided tours and GB overnight educational research events
- Provided video material to Science Screen Report for schools
- Multiple longer educational/teacher training events
- Pre-production planning for new VLA Visitor Center film
- Design completed on VLA Walking Tour signs and brochure/map
- Multiple community outreach events

- **ALMA Specific EPO Activities**

- ALMA broadcast documentary uplinked to PBS stations nationwide. Gets good review. Broadcasts will start in October.
- Production commenced on a series of 12 short (3-5 minute) web videos about topics not covered in the main film underway.
- Press release on ALMA and Astrochemistry, with accompanying video, released and makes it to the NSF home page
- Hosted visits from German & NSF film producers making ALMA documentaries
- Hosted visit from National Geographic to plan long ALMA photo essay expedition
- NBC Rock Center ALMA segments aired 5 July; NRAO web traffic increases 7X



J. Stoke

**VLA Guided Tours:** NM Tech International Summer Science Students tours (32); July 31 Judith Sandwiess Tour (28); July 31 Sevilletta Star Party (23); Rio Rancho Summer tour (18); Manuel School tour (19); August 18 NM Tech VLA tours (38); London Architectural group tour and star party at the VLA (22); August 19 NM Tech Gym VLA tour (28); August 26 Albuquerque Astronomical Society Tour and antenna climb (58). **GB Overnight Educational Research Events:** National Youth Science Camp; Venture Scouts (PA); Civil Air Patrol (WV); NOVAC Almost Heaven Star Party- Tour and overnight to use the 40 Foot (DC area); Boy scout troop 505 (VA); Boy scout troop 81 (VA); Boy scout troop 63 (WV). **Longer educational/teacher training events:** Chautauqua Short Course for teachers in Socorro (8 attendees); Pulsar Search Collaboratory (PSC) Workshop in Socorro (13 teachers, 1 from Texas); Week-long PSC Teacher and Student Leader Institutes (66 students and teachers from WI, CO, VT, MD, IL, MI, VA, OH, ME, WV. 4 teacher mentors, 2 grad students and 6 undergrad students also participated); 2 week long WV Governor's School for Math and Science (60 rising 9<sup>th</sup> graders from WV); Week-long Educational Research in Radio Astronomy workshop (annual camp led by UNC Chapel Hill). **Community Outreach events:** Annual GB Family Science Day Open House (592 guests); GB Train ride Star Party with NRAO staff in partnership with Mountain Rail; August 8: Loma Library ABQ Starlab (5 shows-87 attendees); September 29 "M" Mountain fly in solar scopes – Socorro; August 29&30: Visit to PSC teacher Wynell Henson, Box of Stars training and star party; Cosmic Carnival, ABQ Balloon Museum; TAAS speaker with Miller Goss, topic: Bracewell Sundial; produced posters for 2012 Jansky Lectures and updated website; designed new ads for Green Bank. **ALMA documentary review:** <http://p3publicmedia.com/2012/09/06/into-deep-space-a-program-your-audience-can-get-into/>. **ALMA documentary "web extra" video titles/topics:** ALMA's First Science (early science results); Building Blocks of Life (astrochemistry); The Amazing Atacama (natural history of the region); The ALMA City (OSF and the life of ALMA workers); Tiny Tech (oscillators and SIS Mixers); Atacama: Gateway to the Stars; The Science of Radio Astronomy; Perfecting the Surface (holography and surface-adjustment process for GD/Vertex ALMA 12 meter antennas); ALMA's Partners (what North America, Europe, East Asia, and Chile are contributing to the ALMA project); Imaging a Black Hole! (the "Event Horizon Telescope"); Why ALMA's Antennas Move (antenna baselines and image characteristics); The Extremes of ALMA (ways in which ALMA pushes technology, science, and people past previous limits). **ALMA/Astrochemistry release & video:** <http://www.nrao.edu/pr/2012/widespectral/>. **German film crew visit:** Marco Polo Films of Germany visited 6-10 August for filming ALMA scientist interviews for documentary to air in Europe later this year. **NSF film crew visit:** Crew from NSF's Science Nation short video series visited on 2 August for filming of 2.5 minute ALMA video. **National Geographic:** Met with photo editor and photographer to plan logistics for an extended photo essay shoot at ALMA in November and December. **NBC Rock Center ALMA Segment:** Aired 5 July, seen by millions, big spike in NRAO web traffic the weekend after.

## **Broader Impacts - Diversity**

- Completed Diversity Training for SOC Staff
- Employee Diversity Group Meeting - Brown Bag Sessions
- Diversity Session Conducted – Unconscious Bias
- NSF Review Briefing
- HR coordinated visiting graduate intern appointment for Kenyan student to work with Dr. Kartik Sheth



F. Giles

Diversity training conducted for SOC staff in July. Sessions recorded and included on diversity web page for staff unable to attend.

Employee Diversity Group Brown Bag session – topic EDG Charter and NRAO Demographics & Diversity topic.

CV Employee Diversity session – Unconscious Bias Topic – recorded for future viewing on Diversity website.

Provided Diversity update briefing to NSF Management review panel.

HR coordinated visiting graduate intern appointment for Kenyan student to work with Dr. Kartik Sheth.

## **Broader Impact - Diversity New Hires**

- **Green Bank**
  - 4 White Females
- **Socorro**
  - None
- **Charlottesville**
  - None



J. Firmani w/ input from Giles/Franks

GB Diversity new hires – 3 Janitors; 1 Post Doc

## **Broader Impact - Diversity Promotions**

- **Green Bank**
  - None
- **Socorro**
  - None
- **Charlottesville**
  - 1 White Female



J. Firmani w/ input from Giles

Diversity Promotion – Web Media Writer - Producer

## Agenda

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



## Observatory Support Services - Human Resources

### • Key Human Resources Accomplishments

- Completed nonexempt staff FMLA review
- Completed reduction in force process
- Updated Workforce Management Plan
- Completed Family Leave Policy
- Developed Workplace Conduct policies and brochure
- Initiation of Observatory-wide HR employee and management training program
- Achieved 100% completion of 2012 NRAO Performance Evaluations



J. Firmani

**Completed nonexempt staff FMLA review** – Shirley Franks (Sr. Compensation Analyst) completed the review of positions to ensure NRAO is in **compliance with Fair Labor Standards Act (FMLA) regulations**. The classification of positions were changed in the **4<sup>th</sup> Qtr** after the need for a correction was identified in the review.

**Completed reduction in force process** – The reduction in force was **announced as planned on July 10<sup>th</sup>**. **Ten (10)-employees were laid off during the 4<sup>th</sup> Qtr** as part of the FY2013 budget reduction process.

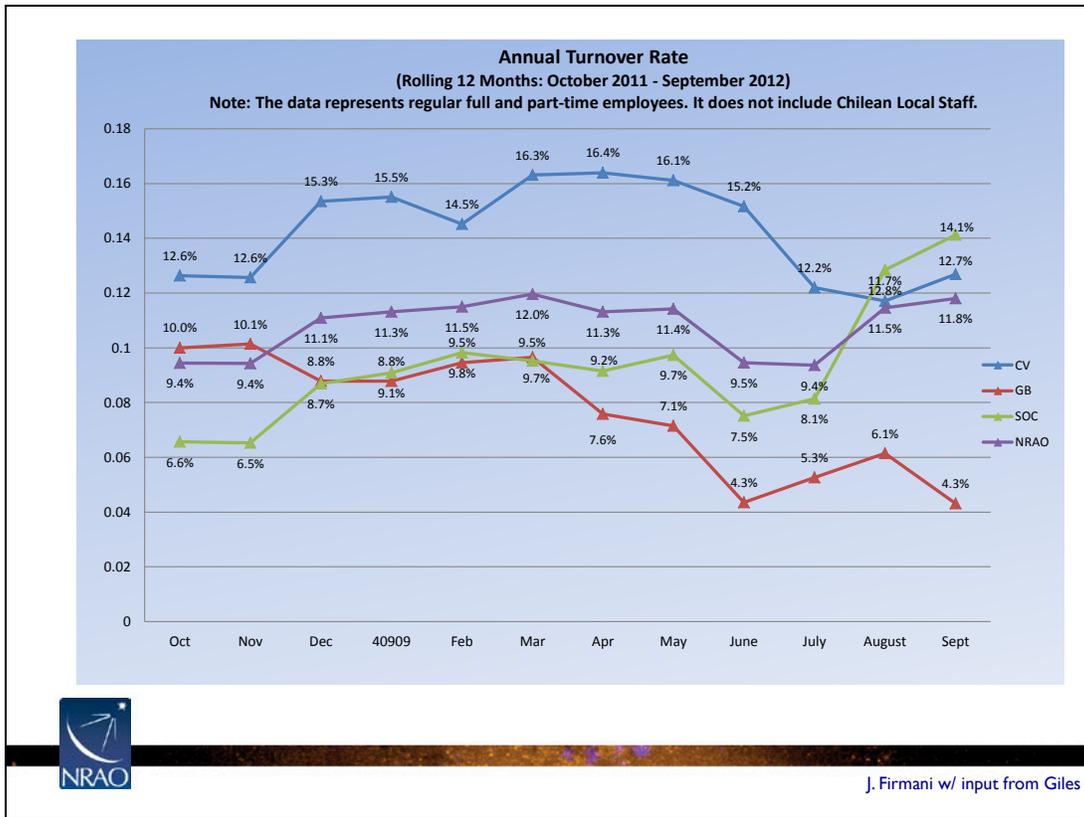
**Updated Workforce Management Plan** – Updated NRAO's **Workforce Management Plan** from its **original issue date of September 1, 2009**.

**Completed Family Leave Policy** – Completed Family Leave Policy that will go into **effect on January 1, 2013**. **Employees were informed** of the policy during NRAO's benefits open enrollment meetings **in October 2012**.

**Developed Workplace Conduct policies and brochure** – **Three new policies** were developed by HR to **support positive workplace conduct** by and for NRAO staff. These policies are designed to **establish clear Observatory-wide leadership and conduct expectations** for managers and employees and include the **Code of Ethics and Standards of Conduct Policy, Workplace Bullying Policy, and Performance and Conduct Policy**. A **Workplace Conduct at NRAO brochure** was also developed for current and new NRAO employees. It will be the **key communication piece** used to **inform people of NRAO's commitment to a professional work environment**. The policies and brochure will receive final approval and be communicated to staff in **1<sup>st</sup> Qtr FY13**.

**Initiation of Observatory-wide employee and management training program** – NRAO Human Resources initiated the process of **expanding the responsibilities of an existing position on the HR staff** that will **lead the development and delivery of employee and management training programs** throughout the Observatory. The **first training program** is scheduled for **delivery in the 2<sup>nd</sup> Qtr FY13**.

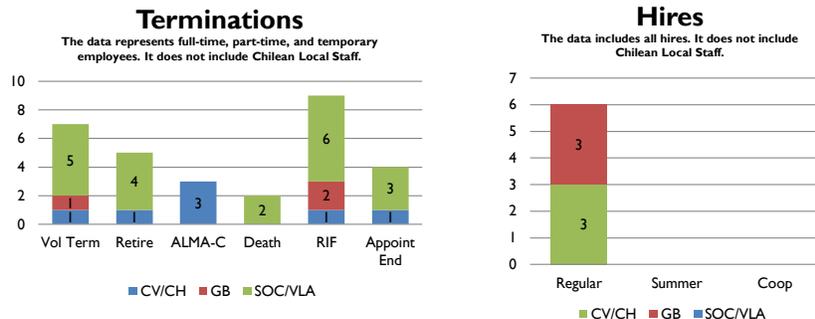
**Achieved 100% completion of 2012 NRAO Performance Evaluations** – Through the leadership of the NRAO Director and the leadership team, NRAO achieved a **100% completion rate** from its **2012 Performance Evaluation Process**.



The annual termination levels from Qtr. 4, 2011 through Qtr. 4, 2012 increased for SOC and CV and reflect a **mixture of voluntary resignations, ALMA Construction roll offs (3), retirements (5) and end of appointments (4)**. During Qtr. 4, due to NRAO Operation Budget cuts for FY1311 employees were terminated.

It is projected that ALMA-C roll-offs will not increase significantly during Qtr 1.

## Observatory Administrative Services Change in Staffing



J. Firmani w/ input from Giles

Charts provide a breakdown of terminations and new hires for Qtr 4 2012

### **Terminations:**

Voluntary Terminations: 1 white female – GB  
1 Hispanic male – SOC; 4 white males  
1 white male - CV

Retirements: 1 white male – CV  
3 white males – SOC; 1 Hispanic Male

ALMA-C Roll Offs: 3 white males

Deceased: 2 white males – SOC

Appointment ended: 1 white Female – CV  
1 Hispanic male – SOC; 1 white male – SOC; 1 white female - SOC

RIF – NRAO Ops FY13 Budget cuts: 1 white female – CV  
2 white males – GB  
2 Hispanic males – SOC; 4 white males – SOC

New hires: Of the six new hires: 2 white males Web Developer and Jansky Fellow - CV  
1 white male Assistant Scientist – CV  
2 white females – Janitors – GB  
1 white female – Post Doc – GB

## Observatory Administrative Services - Computing & Information Systems

- **Common Computing Environments (CCE)**
  - Completed design for **Single-Sign-On** for ALMA and NRAO Helpdesks
  - NAASC Cluster now **producing ALMA QA2** products for NA observers
  - Successfully installed and tested **CASA pipeline tool** on NAASC Cluster
  - Full replica of **GBT and legacy GB instrument archive** data now in CV
  - **ALMA Cycle I call** preparations completed at NAASC
  - Distribution of **Red Hat Linux v6 OS** in final release testing
- **Networking and Telecommunications**
  - Initiated **HD video installation** to all 3 NRAO auditoria (CV, GB, NM)
  - AUI sponsored bid issued for **OSF-SCO Multi Gigabit link** issued
  - **GB 10Gigabit Router Hardware** award finalized
  - Successful **NRAO Proposal Webinar** with 50+ hosted
- **Security**
  - Installed **swipe access to HR and CV computer room** for HIPPA and audit
  - No production impacting security incidents: Focus on Q4 travel to China



D. Halstead

### **Common Computing Environments (CCE)**

**Unification of Helpdesks** on track: **Account Association** (NRAO and ALMA) due in Q4

- Cluster CPU capacity sufficient to allow **ALMA QA Level2** moved from **JAO** to **NAASC**
- **CASA Pipeline** installed on NAASC compute cluster and test runs successfully executed
- Replica of **all GBT data now present in CV** (awaiting Archive Access integration)
- Science Portal and Helpdesk **ready for ALMA Cycle I call**
- **64bit Linux v6 ready** for Q4 deployment

### **Networking and Telecommunications**

- Replacement of 3 end of life video conference units with High Def systems (reduce travel, improve communication)
- AUI RFP to install **fiber optic cable to the ALMA OSF** was issued: selection in Q4
- Hardware and **fiber build-out for Green Bank** high speed Internet link finalized for Q4 start
- **Online training for NRAO proposals** hosted with 50+ Observers participating in presentations, video + Q&A

### **Security**

- Security audit recommendation addressed with installation of **swipe access to HR and IT**
- No production impacting security events: **China safety/security planning** underway for IAU

## **Observatory Administrative Services**

### **- Observatory Business Services**

- **Business Services**

- Completion of travel web page
  - Updates sent to CIS. Changes will be implemented as part of website migration to Plone (FY13Q1)
- Automated reports generation and publication
  - Delayed – This project will be superseded by efforts of new Head of Observatory Budgets to research and create a new WBS alignment.
- Reports review
  - Completed
- ER surveillance and security enhancement systems
  - Completed



S. Geiger

Current reports may be changed due to new WBS alignment. This project will be considered for 2012 POP. Risk: Low. Mitigation: Current reports still work.

Surveillance cameras at Edgemont Road have been upgraded. Security door for after hours to Human Resources/Administration hallway has been installed

## Observatory Administrative Services - Observatory Business Services

### • Environmental Safety and Security

- Site risk assessments through job safety analysis (Q1, Q2, Q3, Q4) continue at all sites.
- VLA Safety Technician passed the OHST test on September 28. Certification by the Board of Certified Safety Professionals
- All training and inspections complete for Q4
- 163 employees trained July-September
- A review of the LWA+ I environmental permit was completed and construction was cleared.
- Review/Rebid of the Workers' Compensation insurance plan resulted in a savings of \$30k for FY2013.
- Monitor work areas of ASIAA, AIP project, D-rack room conversion and the LWA+I.



S. Geiger

**Site training:** CV: successful fire Drill conducted; GB: conducted respirator review for the only employee on the program; SO/VLA: conducted Driving Safety-25 employees; Hang up and Drive-32 employees, Winter Driving-33 employees; New Employee Safety Orientation-6 employees; Maintaining Your safety-30 employees; Lockout/Tagout-2 employees; Hang Up and Drive-32 Employees; Hazard Communication-35 employees.

**Recycling:** VLA: 110 gallons used grease/oil; 100 gallons used water soluble cutting oil; 882 gallons of used oil; approximately 3500 pounds of metal; 45 pounds of batteries/small disposable electronics; GB: 300 pounds of cardboard and 35 pounds of small batteries were recycled.

**Inspections/Testing:** VLA: monthly generator logs audit completed with no defects; monthly fuel system inspections completed; Antenna 2 pre-return to array safety inspection; correlator room FM-200 fire suppression system inspection/testing completed; antenna inspection completed; fuel System Gasoline Storage Tank Twenty Year Structural inspection Per STI SP001 conducted; antenna 911 system tested; site 9-911 system tested; started first aid kit annual inspections; monthly fire extinguisher inspections being conducted on all building fire extinguishers and quarterly extinguisher inspection on antenna extinguishers. NTC: fire extinguishers inspected July-Sept-one extinguisher replaced in October; GB: annual self OSHA site inspection completed with some minor housekeeping issues found (items to be fixed).

**Emergency Services:** Two VLA fire brigade members attended NM Fire Academy Hazardous Materials Awareness & Operations training; new radios installed on new ambulance; rope rescue offsite training with 6 members in attendance.

**Other: VLA/Socorro:** Provided safety oversight for the Antenna 10 separation for azimuth bearing replacement; continued to assist and monitor the work progress at LWAI site for the LEDA out riggers project; Provided oversight for the LWA2 (North arm) trenching; Provided safety and assistance during West arm switch replacement.

## **Observatory Administrative Services - Observatory Business Services**

- **Fiscal**

- Completion of FY 11 OMB A-133 Audit with audit report issued February 14, 2012.
- Submission of NSF OIG requested “Incurred Cost Submissions” (ICS) for fiscal years 2009 and 2010 and preparation of ICS for fiscal year 2008.
- Transition of vendor payments to Automated Clearing House (ACH) transfers is complete, additional vendors are added as invoiced.



S. Geiger

The AUI/NRAO OMB A-133 Audit report for fiscal year ended 09/30/11 contained an unqualified opinion with no findings, material weaknesses, questioned costs or required audit adjustments. In the report on Internal Control on Compliance, the auditors noted one significant deficiency pertaining to support of salaries and wages specific to the Office of Chilean Affairs. Management’s response to the deficiency documented three actions that were immediately implemented to correct the deficiency.

## **Observatory Administrative Services - Observatory Business Services**

- **Management Information Services**

- Complete major Oracle J. D. Edwards ERP software upgrade (Q4)-  
Ongoing
- Complete review, consolidation, and rewrite of the financial reports  
(Completion TBD)- Evaluation of scope ongoing; Design of new  
structure ongoing



S. Geiger w/ input from Beverage

Testing continued into FY12 Q4. Going-live set for month of August.

## **Observatory Administrative Services**

### **- Observatory Business Services**

- **Contracts and Procurement**

- Updates to Procurement Manual completed
- The Export Compliance Program Manual is near completion.
- Procurement website has been updated.
- Revised Procurement Manual has been posted to the NRAO webpage
- A beneficial analysis of whether to proceed with the P-Card has been conducted. A determination not to proceed has been made.



S. Geiger w/ input from Cappiello

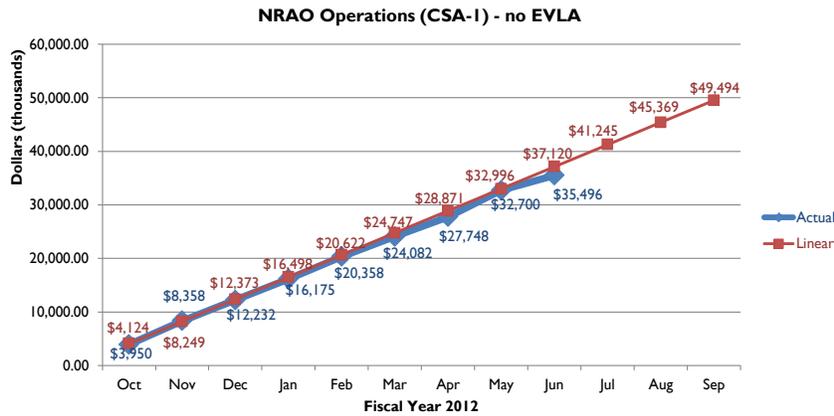
Finalize Procurement Manual Update: The updates have been completed February 2012 (FY12Q2).

Implement an export compliance program: The Export Compliance Program Manual has been reviewed by the AUI Lawyers (Hogan Lovells). We are in the process of incorporating the lawyers comments then will be ready for Director's signature. Program will be in place FY2013. Revise the Procurement website internal and external pages: Website has been updated. All updates/revisions were completed February 2012 (FY12Q2). Revised Procurement Manual has been posted to the NRAO webpage. (FY12Q2).

P-Card Implementation: A beneficial analysis of whether to proceed with the P-Card has been conducted. Determination not to proceed has been made. The P-Card is a purchasing card that provides the ability to purchase supplies on a single account.

## Observatory Administrative Services - Observatory Business Services

- **Financial Performance**



S. Geiger w/ input from Lockledge/McReynolds

NRAO Operations (less EVLA) FY 2012 new funding allocation is \$42,890.0K. Total available funding including prior year commitments and carryover totals \$49,494K. Total expenses and commitments for the first three quarters of FY 2012 is \$35,496K or 71.7% of total available funds. Benefits are ahead of spending projections due to higher than anticipated medical claims and a smaller overall pool of employees from which to recover benefits costs. NRAO budgets for 32.5% benefits rate; however, as of June the actual benefits rate was 36.4%.

# Observatory Administrative Services - Observatory Business Services

- Observatory Work Breakdown Structure - Actual Expenses *pgl*

	Total NSF New Funds (PRL) and Carryover	FY12 Thru Q3 Actuals	% Spent	Notes (75% fiscal year elapsed)
<b>Observatory Science Operations (OSO)</b>	<b>13,314,050</b>	<b>7,627,747</b>	<b>57.29%</b>	<b>OSO Spending increases in 3rd and 4th quarters overall due to summer programs and student research projects.</b>
Observer Support, Services, and Tools	4,298,986	3,758,551	87.43%	Ahead due to computer hardware purchase for GB Archive support and Open Sky expenses.
Community Support Programs	1,604,540	1,088,005	67.81%	Most spending for Community Support occurs in the 3rd and 4th quarters as students come to NRAO for summer projects
North American ALMA Science Center	6,919,647	2,654,513	38.36%	Spending ramps up in summer as students come to NRAO to work with NAASC Scientists. Also, ALMA Telescopes just began receiving data for analysis and research in the 1st Quarter.
Research Experience Teachers & Undergraduates	490,877	126,679	25.81%	Most REU/RET Spending occurs in 3rd and 4th quarters as students come to NRAO for summer projects. \$490.8K is for FY12 and FY13 funding.
<b>Observatory Telescope Operations (OTO)</b>	<b>52,912,657</b>	<b>30,930,973</b>	<b>58.46%</b>	
Green Bank Operations	9,669,702	6,378,152	65.96%	Green Bank's general expenditure trends are weighted toward Q3 and Q4 with summer programs, dorm maintenance/increased usage, cafe operations, and telescope painting.
New Mexico Operations - EVLA	12,752,802	9,585,949	75.17%	
New Mexico Operations - VLBA	5,215,183	3,907,112	74.92%	
ALMA Technical Support and JAO Chile Operations	25,208,559	11,032,122	43.76%	NRAO received \$3.0M in revenue from NRAO's Japanese partners for invoices billed in FY11. NRAO also received \$750K in recovery from ESO and \$983K in LSM Recovery. The remaining funds are for prior year commitments for expenses for future years.
Green Bank Solar Radio Burst Spectrometer	66,412	27,638	41.62%	Solar Radio Burst spending does not follow linear trends.
<b>Observatory Construction Projects</b>	<b>73,598,817</b>	<b>35,427,816</b>	<b>48.14%</b>	
ALMA NA Construction	60,867,193	28,959,969	47.58%	While ALMA-Construction is reported on the POP on a per year basis, ALMA-C is tracked as inception to date by the project. ALMA is forward funded by NSF and the variance is the remaining forward funding and contingency for completion of the project.
ALMA Japan Construction	9,228,624	4,919,230	53.30%	While ALMA Japan is reported on the POP on a per year basis, ALMA-J, as part of the overall ALMA Construction project, is tracked as inception to date by the project. ALMA-J is forward funded by NSF and the variance is the remaining forward funding and contingency carried forward for completion of the project.
EVLA Construction	3,503,000	1,548,617	44.21%	Project completion is expected in FY12.



S. Geiger w/ input from Lockledge/McReynolds

# Observatory Administrative Services

## - Observatory Business Services

- Observatory Work Breakdown Structure - Actual Expenses pg2

	Total NSF New Funds (PRL) and Carryover	FY12 Thru Q3 Actuals	% Spent	Notes (75% fiscal year elapsed)
<b>Observatory Development Programs (ODP)</b>	<b>4,701,194</b>	<b>2,069,501</b>	<b>44.02%</b>	
New Initiatives	582,919	458,198	78.60%	
Coordinated Development Lab	2,269,732	1,558,599	68.67%	AD Position vacant for the year.
ALMA Development	1,848,543	52,704	2.85%	\$500K in development money is being awarded for development studies. Proposals for these funds were just submitted in 2nd quarter of FY12. The remaining money is being held for JAO projects which NRAO was instructed to hold onto until further notice.
<b>Observatory Administrative Services (OAS)</b>	<b>3,864,178</b>	<b>4,721,003</b>	<b>122.17%</b>	
Administration	683,775	355,978	52.06%	Head of Budgets position was open in Q1 and most of Q2. Also, FY11 ERP expenses were accrued at FY11 year end, resulting in a reversing credit in Q1. Some general underspending by a few of the Admin divisions.
Human Resources	823,062	631,904	76.77%	
Computer and Information Services	1,346,596	1,066,676	79.21%	
ALMA Office of Chile Affairs	1,010,745	635,096	62.83%	General underspend is due to reversing accruals of FY11 expenses reversed in October 2011.
Administration Cost Recovery to Rest of CSA-I		2,031,350		The FY12 POP was the first version on the POP prepared using the new Cost Pool Recovery mechanism. As such, the budget numbers were calculated using a version of the Cost Pool Recovery system that was based partly on the former Directly Associated Costs (DAC) method. This line item is the liquidated overhead Administration costs that pertain to the support of the rest of funding source CSA-I, NRAO Ops.
<b>Director's Office (DO)</b>	<b>4,370,997</b>	<b>3,047,984</b>	<b>69.73%</b>	
Director's Office	1,363,109	1,011,004	74.17%	
Science Staff (OSAA)	1,325,886	704,888	53.16%	Some budgeted Post-Doc positions have not been filled as of Q3.
Education and Public Outreach	1,628,630	1,292,252	79.35%	
Spectrum Management	53,371	39,840	74.65%	
ARRA Stimulus Funds	965,700	580,072	60.07%	Funding expected to be used by end of Fiscal year.
Interagency Agreements Assoc. with Base Operations	-	-	-	
Subtotal Interagency Agreements Assoc. with Base Operations	-	-	-	
AUI IDC/Mgmt Fee	3,466,000	2,599,992	75.01%	
NRAO Operations Carryover	3,995,000			Carryover is distributed throughout the NRAO Operations Divisions.
<b>Grand Totals (carryover plus new NSF AST funding)</b>	<b>161,188,593</b>	<b>87,005,088</b>	<b>53.98%</b>	



...distributed through the functional areas and the FY12 budget reduced to reflect the impact of the cost pool recovery...

S. Geiger w/ input from Lockledge/McReynolds

## 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



## Organization Changes

- **Organizing around four Observatory-wide functions:**
  - Science Operations
  - Telescope Operations
  - Development Programs
  - Administrative Services
- **Implemented**
  - Program Management Department (PMD)
  - Data Management & Software Department (DMD)

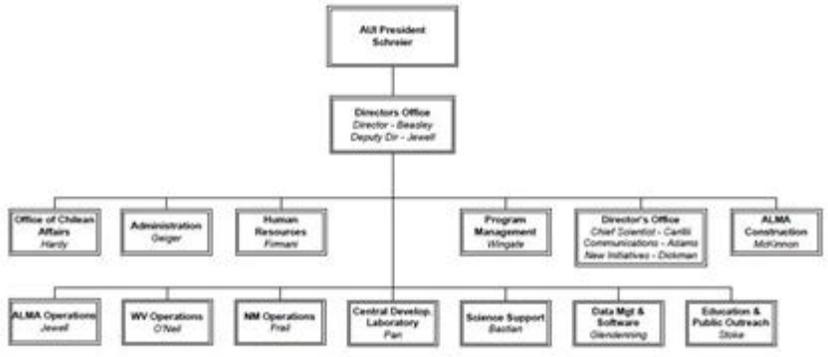


For the past two years NRAO has been reviewing its organization structure, seeking to optimize Observatory-wide function and produce scientific and technical efficiency in NRAO operations. Initial efforts created new structures, including OSO (Observatory Science Operations), OTO (Observatory Telescope Operations), ODP (Observatory Development Program) and other functional groups. Implementation of these structures exposed the need to further define the structure and make some additional changes. However, the basic functional groupings continue to provide a logical construct for describing the scope of work at NRAO.

The specific changes to NRAO management implemented this quarter includes the creation of a Program Management Department (PMD) to provide program and project management support and systems engineering services to NRAO project leaders and PIs. Over the past decade NRAO has gained significant skills/experience in project management and systems engineering, and retaining those abilities and applying them to other areas of the Observatory is critical as we enter a new era where budgets are low, expectations are high, and process is important. PMD will be defined using mainly existing staff. Key goals of PMD are to provide visibility, transparency, and consistency in reporting within NRAO and externally to NSF and outside partners or customers, identify and provide project resources across all NRAO projects (regardless of funding source), to review new projects for alignment in supporting the long-range strategic goals of the Observatory, and continue compiling/editing the key NRAO reporting documents, e.g. NRAO Program Operating Plan.

A Data Management & Software Department will manage areas such as data archiving across NRAO, including access, distribution, provisioning, and operation; reduction pipeline infrastructure implementation and technical operation; high-performance computing platform definition, acquisition, and operation; network provisioning to the external community and between sites; primary responsibility for all user facing software (e.g., CASA, AIPS, PST) and telescope software (e.g., Monitor and Control) in collaboration with the telescope science centers who will provide priorities, testing/validation. These changes will be fully described in the Program Operating Plan for FY2014.

# National Radio Astronomy Observatory Organization Chart



## Director's Office - Office of Science & Academic Affairs (OSAA)

- **General activities and reporting**
  - Wrote/reviewed intro and science sections for NRAO input to Portfolio Review response
  - Science and OSAA sections for LRP, POP finalized
  - Science highlights for NSF, AUI, other sections
  - Users committee response: scistaff activities
  - Scientific input and advice to Newsletter, press releases
- **Recruiting**
  - ALMA Ops AD interviews and selection
  - Review ALMA-Chile candidates and compensation with HR
- **Budget:**
  - SAA budget review for Director's Office
  - Finalized unallowables, FY2013 science meeting support
  - OSTC ODP review proposal circulated to ADs



C. Carilli

A key part of the chief scientist role is scientific input into numerous reporting documents and venues, as well as scientific press releases and EPO-related highlights.

The chief scientist also participates in the Director's review of selected observing programs to identify emerging science themes.

Head of OSAA participates in all scientific staff hiring either directly on the selection committee, or via a post-selection review to set appointment level (assistant, associate...) with HR. This includes NRAO hires to ALMA in Chile, for which we had a few this quarter.

Development project review is evolving under Program Management office.

OSAA provides budgetary support for schools and scientific meetings sponsored in whole or part by the NRAO. These schools and meetings are a key part of NRAO education and professional out-reach and development, and foster a vibrant community in the use of NRAO facilities. OSAA supported the synthesis summer school, and other events.

## Director's Office

### - Office of Science & Academic Affairs (OSAA)

- **Scientific Staff**
  - **Scientific staff policy manual revision**
    - Emeritus and gradual retirement sections drafted w. HR
    - Charges for revision of SSPM drafted, including: post-tenure review, PRC streamline, codify PEP-PRC relationship and scistaff definition
  - **Scientific/OSAA Performance Evaluation (PEP)**
    - Completed for scistaff and SAA
  - **Academic promotions**
    - Memo to PRCs outlining delay due to SSPM revisions
    - Adjunct appointments reviewed
- **Jansky lecture**
  - Mark Reid lectures organized



C. Carilli

SAA is leading a revision of the SSPM, including post-tenure review, PRC streamlining, emeritus and gradual retirement, and related. Committee established with SAA, SRR, HR, AUI representation.

OSAA performs the scientific review of section 3 or all scistaff, including astronomers, scientists, research engineers and computer scientists (roughly 90). This process is now complete for 2012, barring a few stragglers.

The academic promotions process has been placed on hold until the SSPM revision is complete.

OSAA organizes the Jansky lecture.

## Director's Office

### - Office of Science & Academic Affairs (OSAA)

- **NRAO and NAASC postdocs: mentoring and oversight**
  - Jansky quarterly telecon: science presentations and general news
  - Jansky fellows: revised starting dates, computing resources for three new fellows
  - Jansky fellows: considered visa issues for foreign fellows
  - Socorro and GB project postdocs participate in telescope commissioning and software testing
  - NAASC postdocs contributed to ALMA Cycle I technical reviews, various ALMA databases, ALMA helpdesk
  - REU: postdocs supervise undergraduate students in summer research
  - Science activities at all the sites include: lunch talks, colloquia, science tea, journal clubs, often lead by postdocs
  - Training includes: Interferometry discussion group, Python programming training, radio technique schools, CASA workshops, and related
  - Postdocs attended conferences, wrote papers, conducted observations



C. Carilli

#### Postdoc:

- Jansky fellows held their quarterly telecon, with a science talk by Laura Chomiuk
- Michael Busch came to Socorro as a Jansky fellow
- In Socorro, N. Roy participated in RSRO commissioning. Minnie Mao started as a project postdoc for EVLA. Goss advised Jy fellow on career development.
- Socorro pizza lunch is organized by Jansky fellow M. Mao
- Cville tuna lunch is organized by postdocs N. Marcelino & JC Munoz
- GB journal club and colloquia are organized by postdoc M. Johnson
- Cville astroph discussion group led by postdocs K. Scott, JC Carlos, J. Tobin, as well as numerous informal topical discussion group

#### Naasc postdocs:

- Contributed to ALMA Cycle I technical reviews
- Contributed to Splatalogue database
- Contributed to ALMA calibrator database
- Lead weekly lunch talk series and journal club discussion group
- Conducted ALMA data calibration and imaging for delivery to Pis/community
- Interferometry Discussion Group
- Python programming training
- Journal club
- Various science topic specific group meetings

## **Director's Office** **- Communications**

- **External Stakeholder Communications**

- Prepared FY 2012 Annual Progress Summary for delivery to NSF
- Collaborated with Director's Office staff to organize and execute Users Committee teleconference

- **Internal Stakeholder Communications**

- Collaborated with Director's Office staff to prepare and distribute NRAO employee communications regarding the NSF Portfolio Review
- Collaborated with HR staff on Open Enrollment communications & internal web site content for NRAO employees
- Initiated improved internal web site operations & maintenance enabled by re-hire of Web Developer position



M. Adams

The FY 2012 NRAO **Annual Progress Summary** is delivered to NSF as an Appendix of the FY 2013 Program Operating Plan

**Users Committee tele-con** was held mid-August.

**Web Developer** W. Davis Murphy officially joined the NRAO Communications staff on 24 Sep 2012.

## Director's Office - *Spectrum Management*

- **General Spectrum Management**
  - **ITU-R WP7D meeting in Manta, Ecuador September 2012**
    - Prepared input documents related to protection of radio astronomy from a proposed new allocation to vehicular radar at 77.5-78 GHz
    - Prepared revised version of ITU-R Recommendation RA.1417 concerning a radio quiet zone in the vicinity of the L-2 Earth-Sun Lagrangian Point



H. Liszt

WP7D input documents: One document shows that knife-edge diffraction prevents RF-shielding of radio telescopes at mm-wavelengths by ring-fencing (based on an original calculation by Darrel Emerson, NRAO-Tucson, retired). Another document reports results of testing of a car radar at the ARO 12m telescope in October 2011 by NRAO, ARO, Bosch and Continental. Another document discusses the appropriate value of atmospheric attenuation to be used in interference analyses concerning mm-wave observatory sites.

ITU-R Recommendation RA. 1417 describes the utility of the L2 point for space science missions such as WMAP and PLANCK and recommends that administrations coordinate their earth-space and space-earth communications and data relay to/from the vicinity of the L2 point.