Quarterly Status Update (QSU)
July – September 2010

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

Agenda

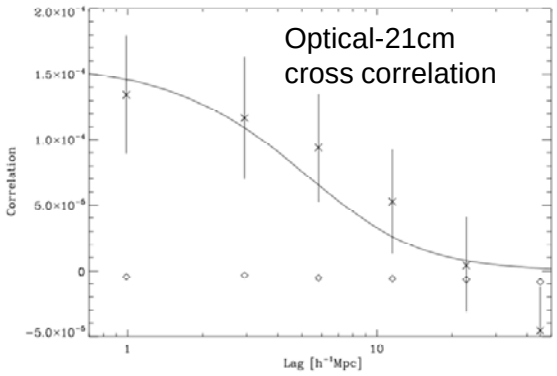
- Science Results
- Metrics/Statistics
- Observatory Science Operations
- Site Specific Activities
  - ALMA
  - VLA/EVLA
  - GBT
  - VLBA
- Observatory-wide Operations

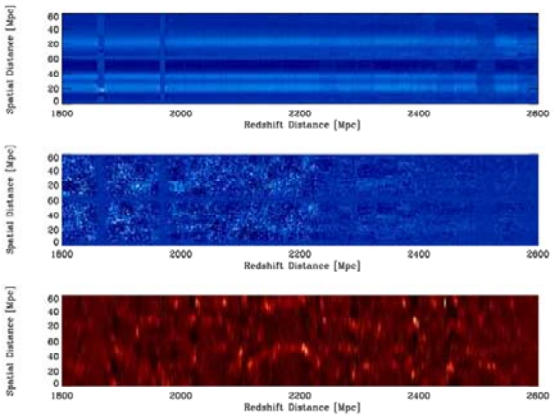
The format followed on this agenda provides orientation to the structure of this briefing, gives some high level science results and metrics, and then reviews Observatory Science Operations, Site Specific Activities, and then Observatory-wide operations.

GBT Science Results

GBT demonstrates new technique for studying dark energy

Using the technique of 'intensity mapping', the GBT has made the first detection of HI 21cm emission at substantial redshift (z ~ 1). This technique involves low spatial and spectral resolution imaging to detect the aggregate 21cm signal from thousands of galaxies at high z. Cross correlation with optical redshift surveys reveals a robust detection of the mean HI signal from these galaxies. This technique has the promise of mapping large scale structure at high redshift, such as the Baryon Acoustic Oscillations, and hence for determining the nature of the Dark Energy that drives cosmic acceleration. (Chang ea. Nature, 2010, 466, 463)

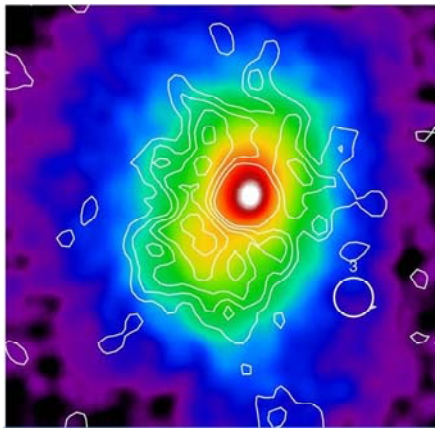




GBT Science Results

GBT/Mustang makes highest SZ image to date

The MUSTANG bolometer array operating at 3.3 mm on the GBT has been used to make the highest angular resolution map to date of the Sunyaev-Zel'dovich effect (SZE) in a cluster of galaxies. The SZE map of the cluster, RXJ1347-1145, made at 10" resolution, confirms the presence of a localized enhancement 20" from the center of the X-ray emission, a feature that is interpreted as an ongoing major merger event. The GBT data also detect a pronounced asymmetry in the projected cluster pressure profile that would not have been detectable in lower resolution observations. With the recent improvements in the GBT surface, high resolution SZE measurements will become a powerful tool for studying intracluster gas.



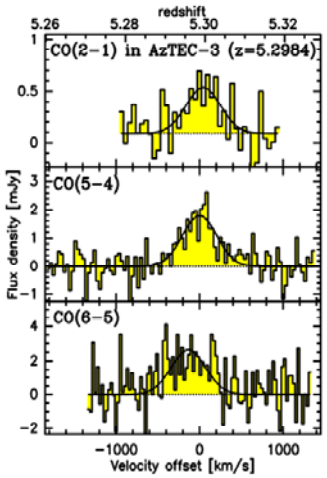
Caption: Contours of the SZE decrement from MUSTANG superposed on the Chandra X-ray count-rate image smoothed to 10" resolution. The anomalous SZE enhancement is the ridge to the left and below the central X-ray source.

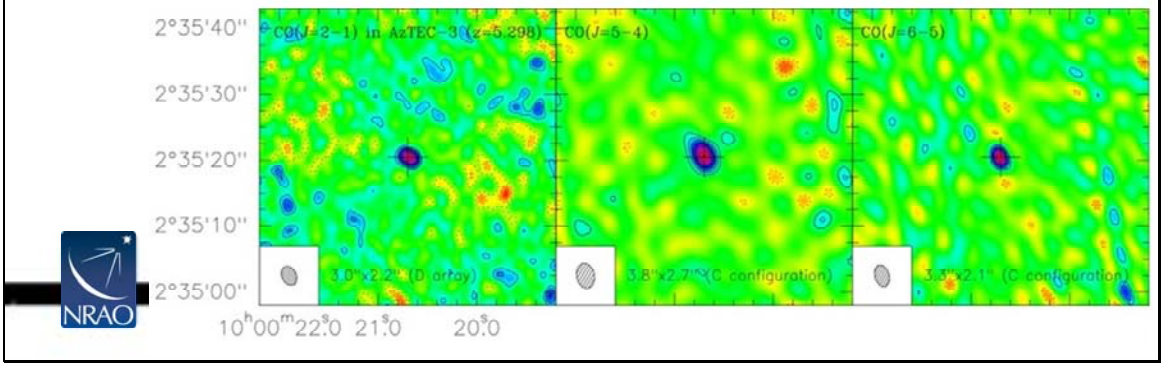
NRAO

EVLA Science Results

First EVLA publications I: Molecular gas in the most distant hyper-starburst galaxy at z=5.3 (t_{univ} ~ 1Gyr).

The EVLA and the PdBI have revealed CO emission from the most distant known submm galaxy at z=5.3. These observations show the cold gas that fuels the star formation, implying extreme amounts (>10^{10} Mo) of dense gas in this forming elliptical galaxy. These observations are fundamentally enabled by the new EVLA receivers and correlator. (Riechers ea. 2010, ApJ, 720, L131)



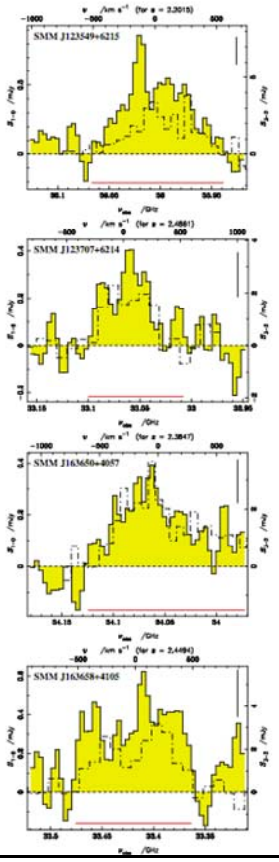


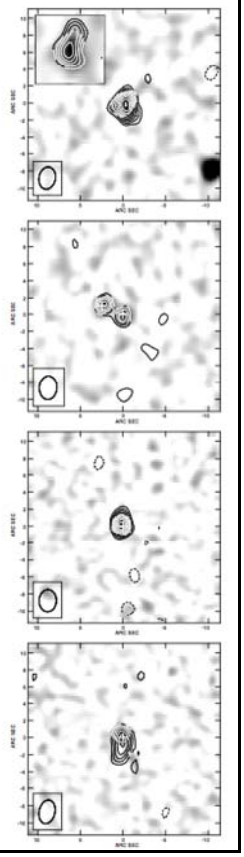
EVLA Science Results

First EVLA publications II:

Extended, low excitation molecular gas in submm galaxies at z ~ 2

The EVLA has revealed low excitation molecular gas in active star forming galaxies at z~2, during the 'epoch of galaxy assembly.' These observations show more total gas, by a factor 2, than previously derived from higher order transitions, and indicate that the gas is extended on scales ~ 16 kpc. These results challenge many preconceptions on massive galaxy formation at high z. (Ivison ea 2010, MNRAS, in press).





EVLA Science Results

VLBA imaging of neutral atomic gas within 1pc of a massive black hole:

The VLBA has been used to image the atomic Hydrogen on sub-pc scales near the active nucleus of Centaurus A galaxy. The HI absorption lines are seen against the radio loud nucleus and jet. It is found that the broadest HI components are located within 1 pc of the nucleus, as opposed to being intervening clouds further out in the di The result indicates that dissociation of H_2 near the nucl is efficient, and may foster the fueling process of the supermassive black hole (Espada ea. 2010 ApJ 720, 666).

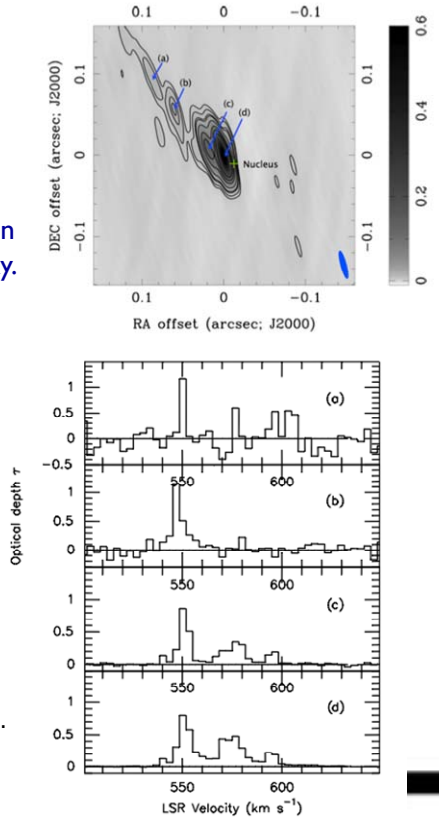


Figure:VLBA image and HI 21cm absorption spectra toward Cen A.

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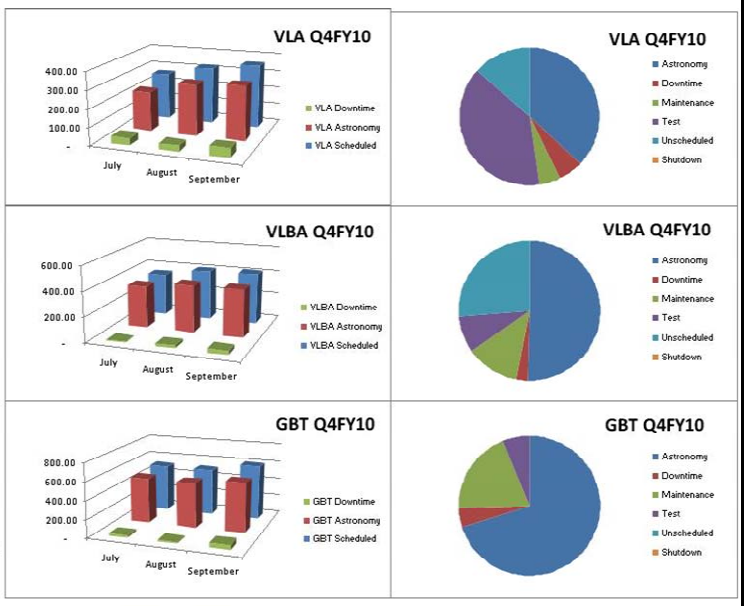
Telescope Utilization (Astronomy, Downtime, Maintenance, Test/Calibration, Unscheduled)

Q4 FY10

			July	August	September
	Available Hours		744.00	744.00	720.00
	VLA Q4FY10	Q4	July	August	September
VLA	Scheduled	942.36	264.38	320.98	357.00
	Astronomy	*818.10*	*223.36*	*289.43*	*305.31*
	Downtime	*124.26*	*41.02*	*31.55*	*51.69*
	Maintenance	114.50	33.50	41.00	40.00
	Test	858.51	340.00	271.67	246.84
	Unscheduled	292.63	106.12	110.35	76.16
	Shutdown	-	-	-	-
	Total Hours	2,208.00	744.00	744.00	720.00
	VLBA Q4FY10	Q4	July	August	September
VLBA	Scheduled	1,168.75	347.00	406.50	415.25
	Astronomy	*1,110.49*	*341.80*	*383.33*	*385.37*
	Downtime	*58.26*	*5.21*	*23.17*	*29.88*
	Maintenance	273.05	104.80	75.25	93.00
	Test	182.55	59.20	59.75	63.60
	Unscheduled	583.66	233.00	202.51	148.15
	Shutdown	-	-	-	-
	Total Hours	2,208.00	744.00	744.00	720.00
	GBT Q4FY10	Q4	July	August	September
GBT	Scheduled	1,644.25	523.00	517.50	603.75
	Astronomy	*1,544.00*	*498.75*	*497.50*	*547.75*
	Downtime	*100.25*	*24.25*	*20.00*	*56.00*
	Maintenance	428.50	168.75	188.75	71.00
	Test	135.25	52.25	37.75	45.25
	Unscheduled	-	-	-	-
	Shutdown	-	-	-	-
	Total Hours	2,208.00	744.00	744.00	720.00



Provided by: G. Hunt

Scheduled = planned observing time.

Astronomy = amount of observing hours that concluded

Downtime = amount of hours lost during observing

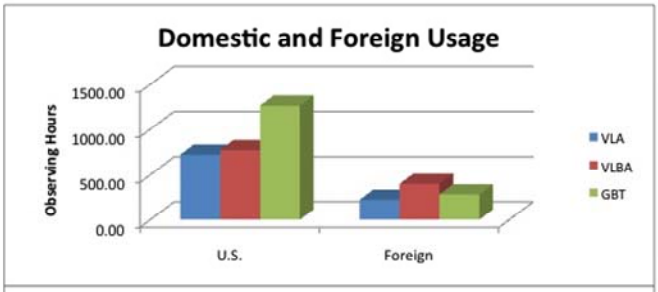
Maintenance = scheduled period for technicians to service. Observing time is not scheduled during this time. This time is considered 'protected' and is not interrupted for targets of observing opportunity.

Unscheduled = time that went idle (unplanned); for example, for VLBA if no media was available or due to the 10 weather environments and the tiger team visits; for VLA if no dynamic project fit, for GBT = holiday.

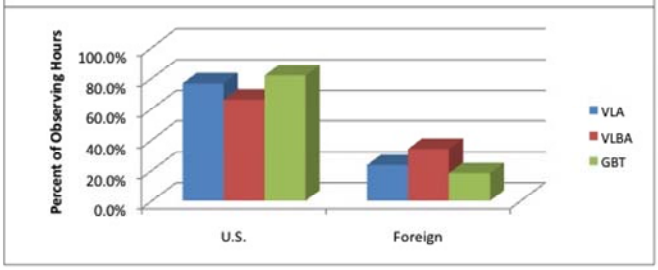
Downtime = faults that occur during a planned observation; e.g., circuit breaker fault, fraction of array unavailable, etc.

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

	U.S.	Foreign	Unspecified
VLA	721.20	221.16	0.00
VLBA	770.50	398.25	0.00
GBT	1262.75	281.25	0.00



	U.S.	Foreign	Unspecified
VLA	76.5%	23.5%	0.0%
VLBA	65.9%	34.1%	0.0%
GBT	81.8%	18.2%	0.0%



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Provided by: G. Hunt

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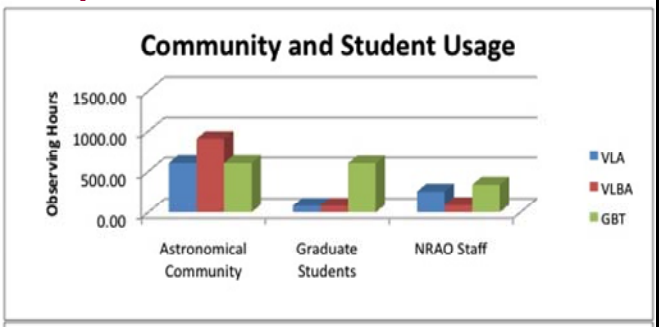
All metrics are compiled by principal investigator, not project team.

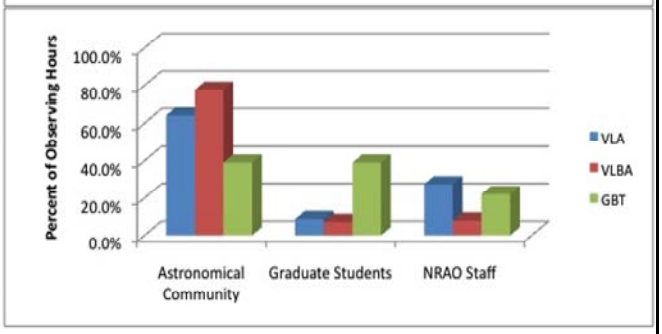
Top graph is in **observing hours**.
Bottom graph is in **% of observing hours.**

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

	Astronomical Community	Graduate Students	NRAO Staff
VLA	603.69	81.22	257.45
VLBA	906.00	83.00	91.75
GBT	602.00	601.00	341.00



	Astronomical Community	Graduate Students	NRAO Staff
VLA	64.1%	8.6%	27.3%
VLBA	77.5%	7.1%	7.9%
GBT	39.0%	38.9%	22.1%



Provided by: G. Hunt

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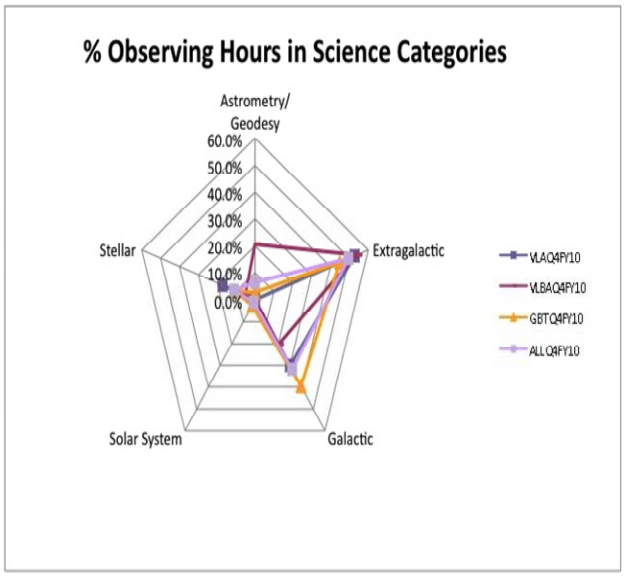
All metrics are compiled by principal investigator, not project team.

Top graph is in **observing hours**.
Bottom graph is in **% of observing hours.**

Telescope Usage by Science Category

	GBT	VLA	VLBA
SOLAR SYSTEM	2.6%	0.0%	0.0%
STELLAR	10.4%	17.2%	5.2%
GALACTIC	39.5%	30.0%	20.2%
EXTRAGALACTIC	44.9%	52.9%	54.0%
ASTROMETRY/GEODESY	2.7%	0.0%	20.7%
UNSPECIFIED	0.0%	0.0%	0.0%



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Provided by: G. Hunt

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This information is obtained from the proposal coversheet which includes scientific categories. The proposals tend to include one to three scientific categories per project. The metrics are created by splitting time (minutes) evenly over the categories listed on the proposal coversheet.

Basic analysis (some trending may be due to seasonal variations in activities; full year trending analysis will be performed at the culmination of the fiscal year):

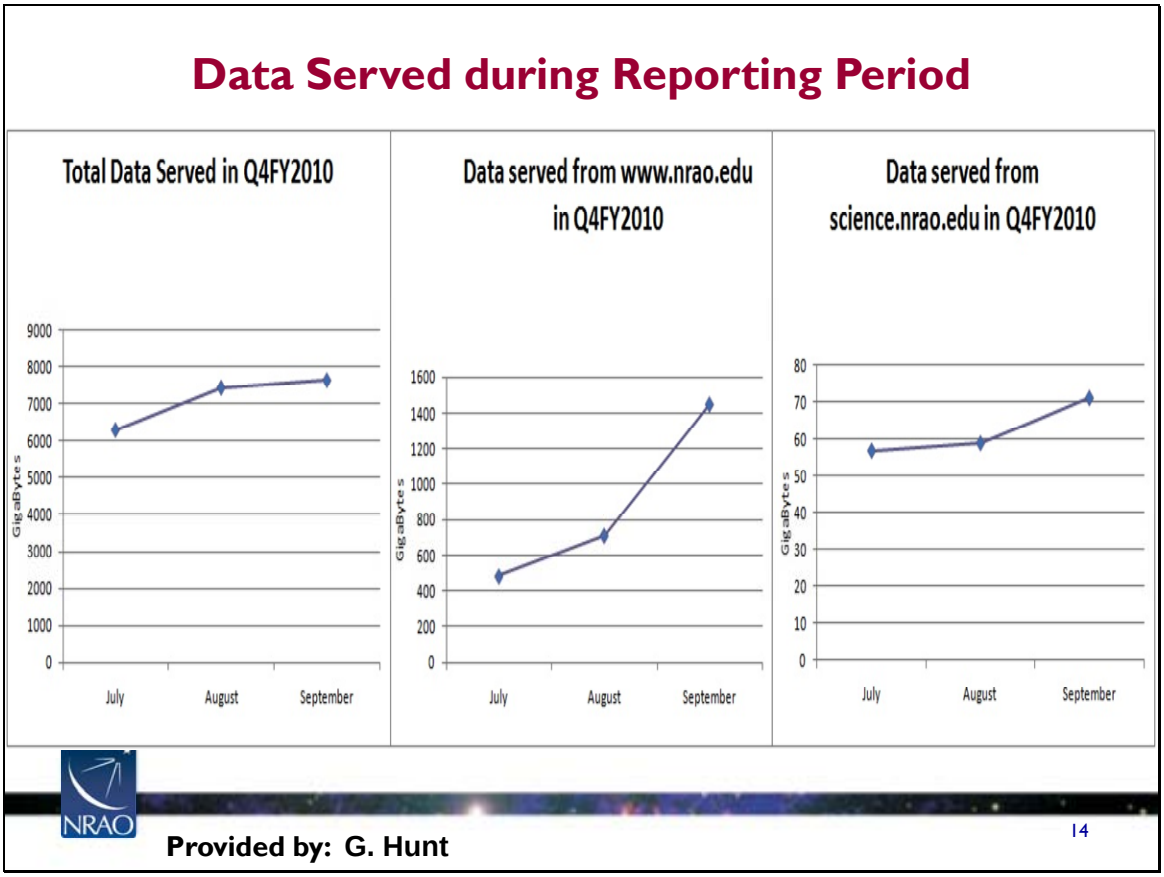
Proposals Submitted during Reporting Period

- None

Provided by: G. Hunt

No proposals solicited during this quarter.

During FY2011, proposals were on a four-month cycle (October 1, February 1, June 1). This will be changing to a six-month cycle in FY2011, beginning with Feb 1 2011.

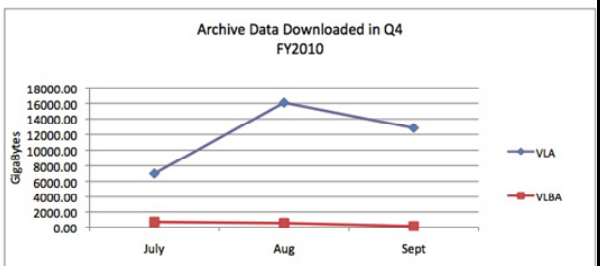


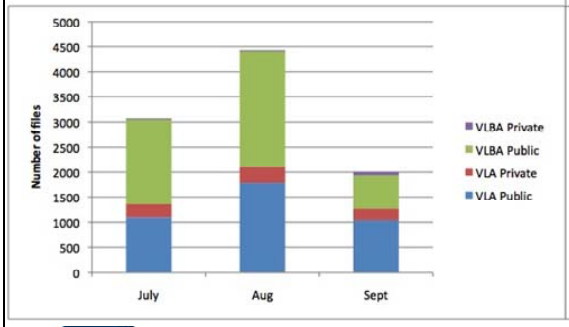
1. Total data served from all web servers.
2&3. Specific plots for the main web site and for the science web site

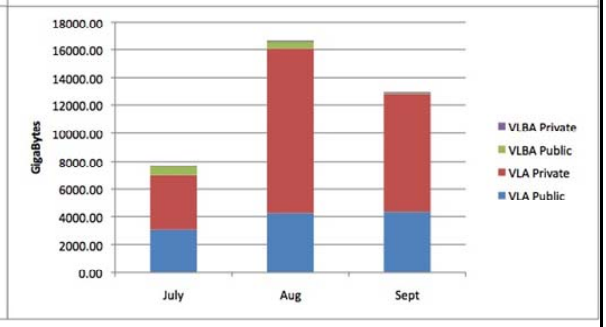
Archive Data Downloaded during Reporting Period

Q4 FY2010 TOTALS

	# of Files	Data Volume (GB)
VLA		
Proprietary	798	24,248
Public	3,923	11,660
Total	**4,721**	**35,908**
VLBA		
Proprietary	75	24
Public	4,700	1,391
Total	**4,775**	**1,415**
Pipeline Images		
Downloaded	**595**	







Provided by: G. Hunt

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Although the three month history does not demonstrate the change fully, this is a really impressive change from the past. Since the commissioning of the EVLA WIDAR correlator in March, the data served by the archive has burgeoned: increasing from 194GB in February to 16,074GB (that's 16.1 TeraBytes) in August, i.e., by more than 8,191% in 6 months!

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OSO Specific Milestones

- ***Organization***
  - FTEs and Costs included in FY2011 WBS
- ***User Communications & Programs***
  - Coordinated schedule of meetings
- ***User Access & Support***
  - Develop plan for integrating ALMA specific functions into NRAO User Portal, Helpdesk and archive functions
    - Helpdesk
      - Implement for beta testing for the ALMA project
    - User Portal
      - Planning for upgrade of NRAO User Portal to accommodate NA ALMA users
      - Prototype for the NA ALMA User Portal, including interfaces to NA ALMA Science Archive, the ALMA prototype Helpdesk, and the ALMA proposal review tools

Provided by G. Hunt/M. Adams/D. Halstead

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The resources (**FTEs and costs**) for OSO were included in the NRAO operating WBS for FY2011.

There is a tool on the science web to **Coordinate and Consolidate meetings** for all subjects and telescopes.

There has significant progress on the **User Access & Support** functions, including successful participation in the first and second rounds of ALMA integrated testing. Planning for the **NRAO User Portal** included a test installation of *Plone* and procedures for a mass migration of existing web content into a *Plone* environment.

OSO Specific Milestones

- ***Observatory Statistics and Metrics***
  - Initiate logging of newly-decided set of statistics and metadata
- ***Archive and VAO***
  - Completion of the strategy for archive storage
  - Finalize planning and initiate implementation of a scalable system in Green Bank, Socorro, and Charlottesville
  - Leverage existing resources at two national computing centers for hosting NRAO data

Provided by: G. Hunt/D. Halstead

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Logging of metrics data is in place

NRAO Archive Strategy is now being executed, leveraging NGAS servers and the successful grant of 200TeraBytes of archive storage from TeraGrid for GBT Pulsar survey data.

Scalable storage systems on-line for EVLA, VLBA, ALMA and GBT data, although work remains on user access tools with focus on survey data for GBT. Backup archive system from Socorro to CV on-hold pending router upgrade in Nov 2011.

Resources at both NCSA (National Center for Supercomputing Applications @UIUC) and TACC (Texas Advanced Computing Center) have been committed for code development and data analysis with data made available through the TeraGrid network as needed.

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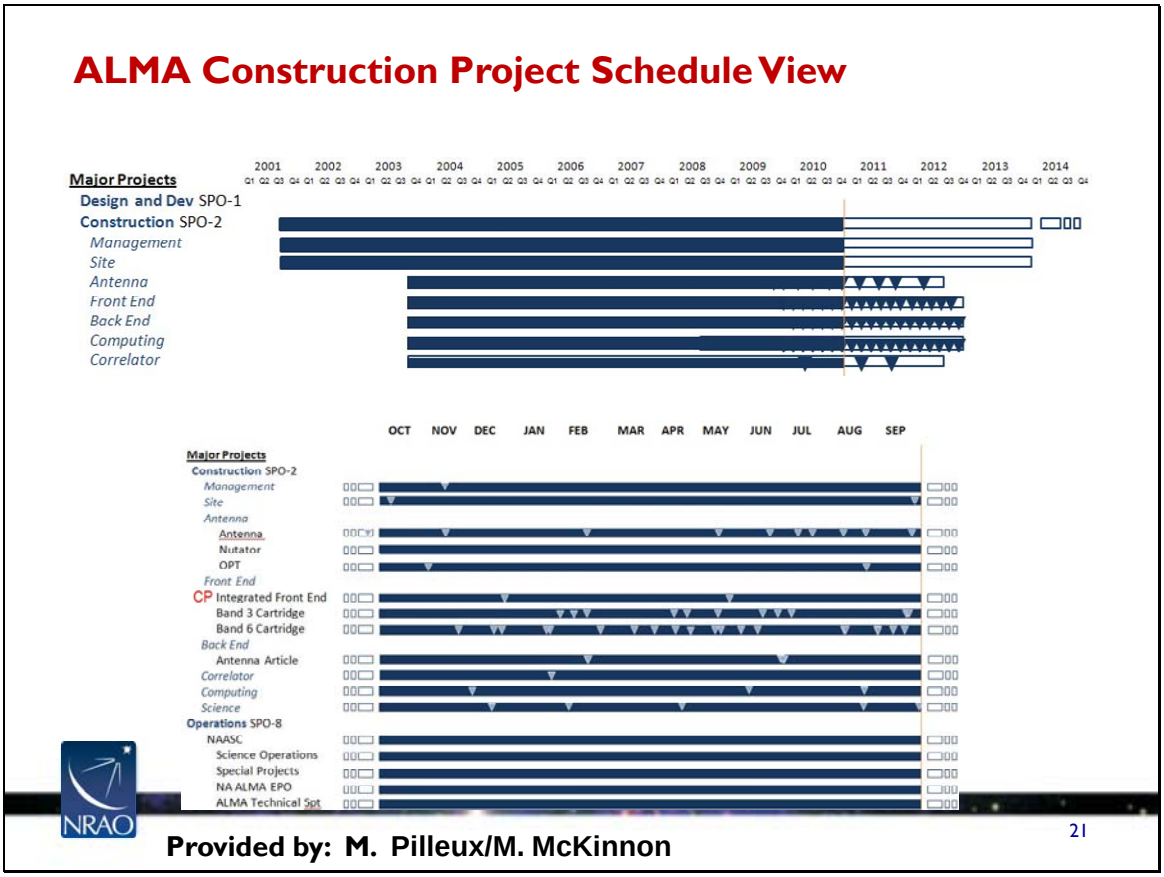
Atacama Large Millimeter/ Submillimeter Array (ALMA)

- Content from a combination of sources
  - ALMA Monthly Reports to NSF
  - NRAO Business Services
  - North American ALMA Science Center



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

ALMA Construction Specific Milestones

- ***Management***
  - No activities to report in this period
- ***Site***
  - Execute the contracts for construction of the AOS power and fiber optic network
    - Contractor failed to perform under the contract terms and was terminated June 30.
    - Litigation is being followed with the former contractor, its former employees and the insurance company holding the policy for correct execution of the work.
    - Rebidding process is in final stages with 2 companies. Work is expected to restart during Q1 FY2011 and execution shall continue until Q2 FY2012.
  - Execute the contracts for AOS road construction
    - On schedule for Q1 FY11
  - Infrastructure Implementation Review conducted 7-8 June in Santiago
    - Action item list being followed up.

Provided by: M. Pilleux/M. McKinnon

MANAGEMENT: There are no activities to report in this period.

SITE: The delivery of **switchgears** continues and will be completed on schedule during October 2010. **The AOS Utilities Contract** was delayed compared to the schedule due to the contract termination on June 30, 2010. The expected date to restart of work is November 2010. A new bid process is proceeding. **AOS road construction** is ongoing, is 58% complete, and will restart in October after the winter break.

The **Electrical Infrastructure Implementation Review** conducted in Santiago 7-8 June 2010 to evaluate the overall status of all electrical infrastructure deliverables has action items that are being followed up.

ALMA Construction Specific Milestones

- ***Antenna***
  - Obtain acceptance for Nutator Unit #1
    - Additional work is being performed on the nutator structure and its servo control system
  - Deliver 4 nutator units to the OSF [Q3]
    - Nutator Unit #1 is most likely to ship to the OSF in Q3 FY2011 for installation on a 12-meter antenna
    - Unit #2 will be fully integrated in Q3 FY2011 and shipped to OSF in Q4 FY2011.
    - Units 3-5 will complete manufacturing and assembly in Q4 FY2011.
  - Deliver 3 optical pointing telescopes (OPTs) to the OSF
    - OPT unit #1 has been used to perform pointing tests of Antenna 10 at the OSF
    - OPT Unit #2 was shipped to OSF for use by NRAO pointing tests
    - OPT Units #3 & 4 are in use for continued testing to solve problem with OPT design.
  - Obtain acceptance of 12 Vertex antennas [Q3,Q4]
    - 7th, 8th and 9th Vertex antennas accepted by ALMA in Q4. Acceptance documents prepared for 10th antenna
    - Antennas 11 through 16 onsite at OSF in various stages of assembly
    - Antennas 17 & 18 complete in US and Germany and await shipment to OSF

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Provided by: M. Pilleux/M. McKinnon

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ANTENNA: Additional structural modifications of the nutator were required as a result of the nutator analysis and testing done in Q3. Single pitch carbon fiber reinforced plastic (CFRP) was required to increase the overall stiffness of the subreflector and Invar counterweights were required to avoid surface deformation due to the mismatch in the coefficient of thermal expansion between the stainless steel counterweights and the CFRP mounts. This material had to be imported to Taiwan. **All structural changes have been completed for units 1 & 2**. The tuning of the nutator's servo control system continues to be a challenge. To speed completion of the tuning, one nutator system will be shipped to Green Bank, WV where the Electronics Division will work in parallel and collaboratively with the engineers at ASIAA who will retain nutator #2 to work with. The risk posed by the delayed delivery of the nutator is a delay in the ability of the Melco (EA) antennas to provide the total power measurements required by some science projects. The risk is being mitigated with a contingency plan that implements a fast scanning technique on the Melco antennas.

The **Production OPT (POPT)** Unit #1 was successfully used to perform acceptance testing on Vertex Antenna #10. The all-sky and offset pointing measurements were consistent with earlier testing with prototype OPT. Unit #1 will be transferred along with Antenna #10 to AIV for their use and Unit #2 will be used by AIPT for testing on Antenna #11 and on. A new objective lens design and construction was completed by colleagues at HIA using a lens mounting technique first developed for the GMOS instrument on the Gemini Telescope. This lens was tested and reduced the amount of temperature dependency by approximately 50%, but did not completely eliminate the drift. The remaining contributor has been found to be the CFRP optic tube. The existing tube is manufactured

using a 45° cross-hatch pattern of multiple layers of fabric. A new CFRP tube is going to be manufactured using unidirectional CFRP pre-pregnated material.

During Q4 FY2010, the **7th, 8th and 9th Vertex antennas were accepted** into ALMA, and acceptance documentation for the **10th Vertex antenna is being finalized**. Thus, the planned acceptance rate of 3 antennas per quarter was achieved. The acceptance of DV10 was delayed approximately 2 months due to the refurbishment of #1, the additional inspections of #1 to uncover root cause of surface degradation, and commissioning of Production OPT for use in acceptance testing. NA AIPT expects to deliver 2 antennas (10 & 11) in Q1 FY2011. A significant event in Q4 was the **investigation and resolution of the root cause of the surface degradation** first discovered on DV02 and later confirmed on DV01. The root cause was damaged panel adjusters that were over-torqued during installation. The over-torquing resulted in plastic deformation to the anchor nut of the adjuster and allowed the adjuster rod to move due to thermal expansion over many months. Vertex inspected 100% of the panels that had moved since the time the surface was initially set and found 21 of 50 adjusters were overstressed and had to be replaced. The correlation between degraded panels and damaged adjusters was 1:1. Lastly, a major effort to resolve a frequent communication problem between the ALMA computer and the Antenna controller was undertaken at the OSF by a team comprised of a Vertex software engineer and an ALMA computing engineer. The root cause was found to be in the CAN BUS driver used in the Vertex antenna. This driver software was rewritten and the problem has not reappeared.

ALMA Construction Specific Milestones

- ***Front End***
  - Reorganization of NA FE IPT management
    - John Effland and Mike Shannon assumed leadership of the NA FEIC for technical and programmatic areas, respectively
  - FE shipments are on hold pending the completion of design verification tests
    - Production continues with the 4th NA FE finished testing this month
  - FE component delivery is now off the critical path
  - Delivered over 40 LO warm cartridge assemblies (WCAs) for Bands 3, 6, 7, and 9
    - Total delivered: 211 (40% of the total requirement)

Provided by: M. Pilleux/M. McKinnon

FRONT END: The **NA FEIC leadership has transitioned** to John Effland and Mike Shannon, who will handle the technical and programmatic aspects, respectively. **FE Components, managed by S. Michalski, is now off the critical path.**

One integrated NA FE underwent testing in Q4, but will be held in Charlottesville to be used for design verification tests. Three more front ends are in process of assembly and test in parallel with the design verification, with delivery of two scheduled for Q1 of FY2011. The delay in shipping will reduce the cost risk of any design modifications but may cause an overload of the AIV process as a large number of FEs will be delivered in rapid succession. **FE LO and test source production** (which compete for resources) are keeping up with the project's needs. **Technical problems with Band 7 WCAs were solved** and full production mode for all four primary bands in underway.

ALMA Construction Specific Milestones

- ***Front End***
  - A total of 35 Band 3 cartridges have been delivered as of the end of Q4
    - FY2010 goal was to deliver 24 Band 3 cartridges. Actual delivery in FY2010 was 28.
  - A total of 32 Band 6 cartridges have been delivered as of the end of Q4
    - FY2010 goal was to deliver 24 Band 6 cartridges. Actual delivery in FY2010 was 28.
  - The final batch of 10 FE support structures are being accepted this month.
    - This closes out the FESS task.
  - Commissioning of second FE test station
    - The fifth NA FE delivery (Cryostat #13) is being tested in the second FE test station with delivery scheduled for late November upon completion of the design verification.

Provided by: M. Pilleux/M. McKinnon

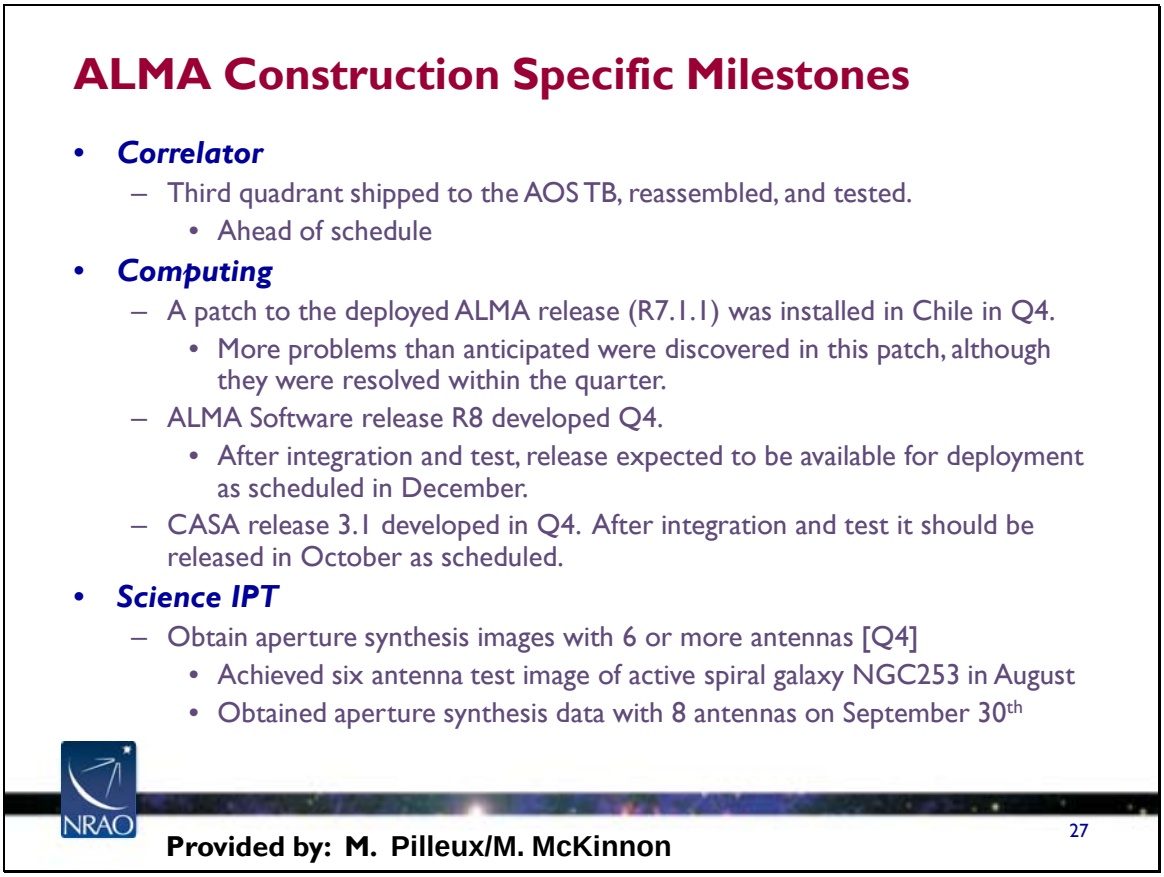
FRONT END: FY2011. The **Band 6 cold cartridge assembly (CCA) is in full production** with the formal approval of the specification change for the cross polarization. **Band 3 CCA** is having problems meeting its cross polarization specification. A **specification change for the cross polarization for Band 3 similar to the Band 6** was submitted. **The remaining FE purchase contracts** were placed and the difficulty of our suppliers not being able to obtain critical components has been overcome and delivery is proceeding as scheduled.

ALMA Construction Specific Milestones

- ***Back End***
  - Deliver antenna articles (AA) to OSF
    - AA 31-40 finished and crated in Q4 as scheduled, but not shipped
    - AA 41-50 begin integration in late Q4; expected to ship at the end of Q1 FY2011
    - Final AAs to be delivered mid-2011
  - Delivered 9th – 16th Line Length Corrector and Sub-Array Switch LRUs
    - Installation and firmware revisions complete delivery of Central LO Article 1
  - First articles for Photonic Reference Distribution received from vendor
    - Final untested deliverables for Central LO Article 2 undergoing acceptance testing

Provided by: M. Pilleux/M. McKinnon

BACK END: **Antenna Articles (AAs)** have continued to be integrated in North America according to schedule with AAs 31-40 crated for shipment in August 2010. The next batch of 10 will be finished and ready for shipment in December 2010. These 20 AAs will be stored in the VLA warehouse until early 2011 in order to maintain warehouse space at the OSF and to minimize costs of any unanticipated modifications to the deliverables. They can be shipped at a moment's notice. The remaining 16 AAs are shipping in mid-2011. **Line Length Corrector (LLC) and Sub Array Switch (SAS) LRUs,** 16 each, were delivered and installed in June and July of 2010 at the AOS. This installation completes the outfitting of the Central LO Article 1, and brings it to its full capability of supporting reference timing for 16 antennas. Looking ahead, the first article units for the **Photonic Reference Distribution** LRUs arrive in late Q1 FY2011 and are undergoing acceptance testing. These items are of interest in that they represent the last new components integrated into the Central LO Article 2 (CLOA2) which is the final photonics deliverable scheduled for installation in Q2/Q3 FY2011. All other components in CLOA2 are add-ons to those in CLOA1 and represent a lower risk.



CORRELATOR: In order to meet the project need for **operating 2 quadrants of the Correlator** simultaneously by April 2010, the delivery plan for quadrant 3 was changed to an earlier date so that engineering tests using quadrants 2 and 3 can be used to verify the 2-quadrant operation while quadrant 1 is used for AIV/CSV activities. Quadrant 4 construction was completed so that a software test bed remains available in Charlottesville. Quadrant 3 was shipped to the AOS TB, reassembled, and passed PAS review. All correlator modes have now been verified.

COMPUTING: The major **problem in the NRAO R7.1.1 portion of the patch** was related to the Data Capture component which assembles the data before submission to the Archive. This component was completely reimplemented (the previous implementation was not maintainable in the long term) and more problems than anticipated were discovered in it after deployment. The major lesson learned however was that the testing needs to include critical CSV developed scripts, including data analysis of the observed data. These will be identified and tested for subsequent releases, including R8. (Globally the major issue this quarter with CIPT software is in the Archive subsystem, which is an European deliverable.)

SCIENCE: ALMA Commissioning started 22 January 2010. The highlights of Q4 included producing a **test image from six antennas at the Array Operations Site** in August 2010. ALMA imaging ability, which goes as the square of the number of antennas, grew through the period as the **AOS array increased to eight antennas**. The eighth antenna was brought into the array the evening of September 30th, with test data acquisition following soon after. The twenty eight baselines available with eight antennas offers a substantial advantage in ALMA's ability to accurately represent emission from the

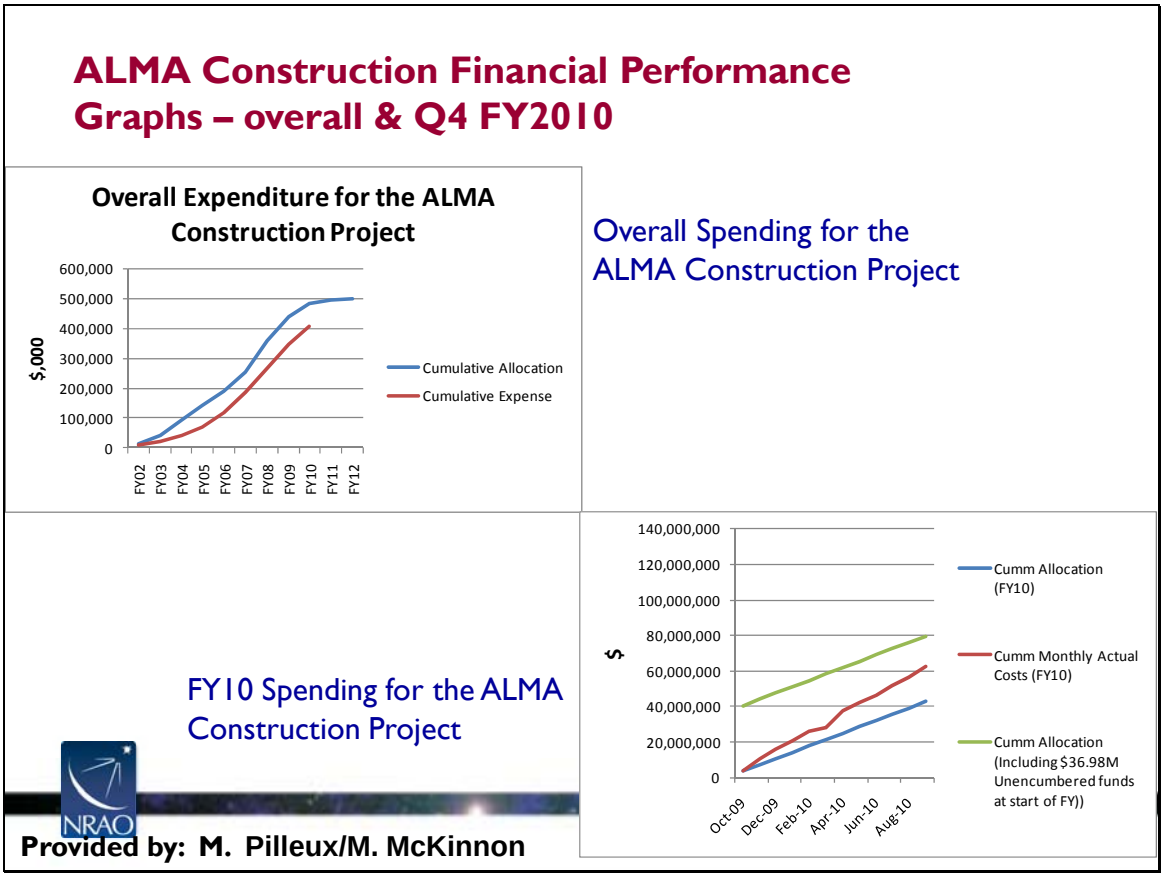
sky - there were ten baselines available at the beginning of Q3. Project Scientist Richard Hills wrote: "We also have data on [NGC253 carbon monoxide emission] at Band 6 (230 GHz) and Band 7 (345 GHz). The band 7 data has also been processed to make a map and [t]here is a plot showing the velocity gradient. The band 6 data was taken with 6 antennas giving 15 baselines and the quality looks good, but at present we only have a short track and we need to take more data before we can make satisfactory test images."

ALMA Construction (SPO-2) Significant Events

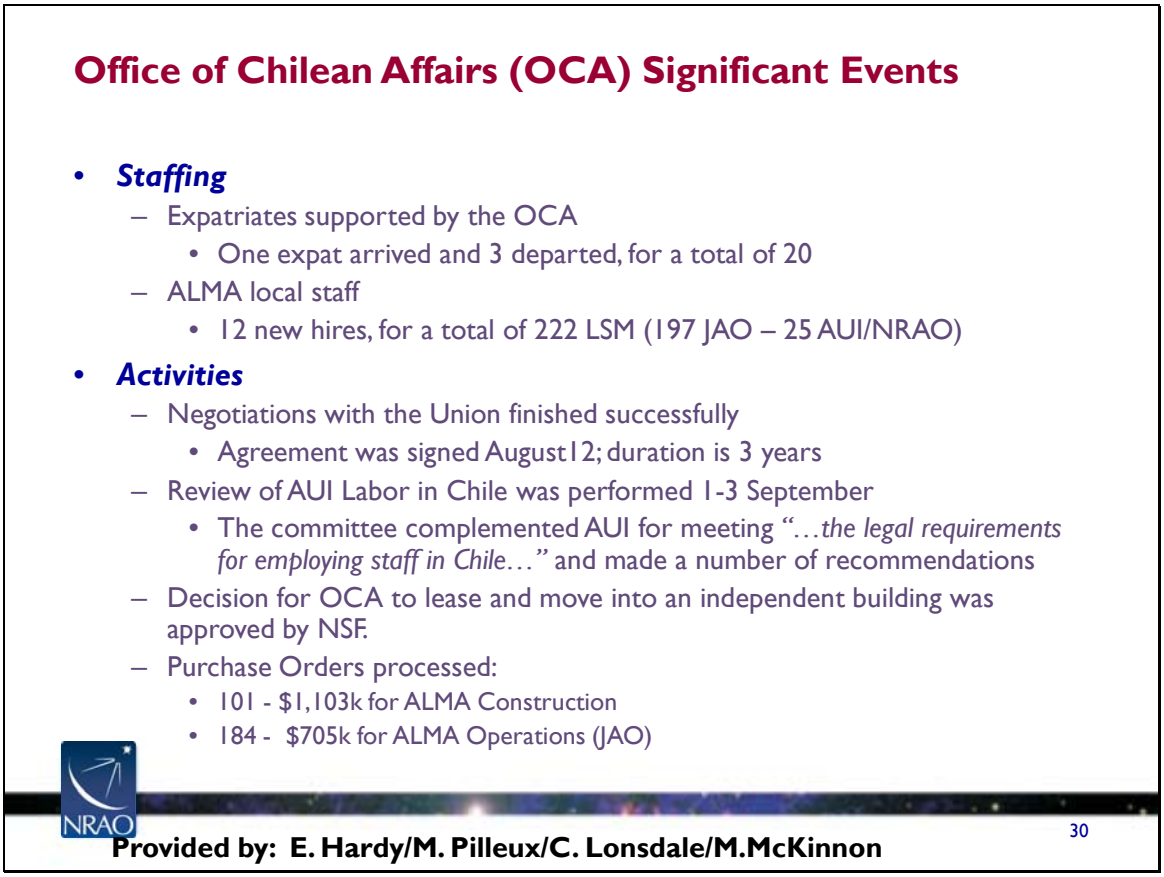
- ***Japan Partnership (SPO-7)***
  - WCA LO drivers were delivered to the EA FEIC via the cold cartridge manufacturers for Bands 3, 6, 7, and 9
  - The first pre-production Band 4 and 8 CCAs were integrated into the third NA FE delivered by the NA-FEIC and extensively tested.
    - The project rejected a request for waiver for the discrepancies and these cartridges will be replaced in the future.
  - Development of an LO driver/frequency multiplier combination for Band 10
    - New design for MMIC power amplifier chips was submitted for manufacturing
  - Frequency multipliers and WCA LO drivers for band 4 and 8
    - Band 4 and Band 8 LO CDR passed; production orders for multipliers are in process.
      - Band 8 multipliers look to be critical path items for Band 8 CCA
  - Components for assembling the fourth EA FEIC FE assembly were delivered

Provided by: M. Pilleux/M. McKinnon

JAPAN PARTNERSHIP (SPO-7) **First pre-production Band 4 and Band 8 Cold Cartridge Assemblies (CCA) were integrated and tested** in NA FE#3. It was determined that Band 4 will need magnets added to the SIS mixer blocks to suppress Josephson current and that Band 8 will need filtered connectors on the cold IF amplifiers. The change control board rejected waivers for these two defects, and these cartridges will be replaced as some point in the future. **Development of an LO driver/frequency multiplier combination for Band 10** with the new designs presently in fabrication. The prototype that was delivered last quarter failed and was repaired and returned. A new design power amplifier chip for Band 10 that was scheduled for fabrication in Q4 will not be ready for tests until Q2 of next FY. **Frequency multipliers and WCA LO drivers were delivered** to cold cartridge manufacturers for use with all bands. A **Band 4 and 8 LO CDR** was held, and designs were released for production**.** Components for assembling Front Ends, including Band 6 cold cartridges, were delivered to all integration centers. The NA FEIC assisted the other integration centers with assembly and test of Front Ends. Support was provided for integrating Front End assemblies into antennas. Components for assembling the **EA FEIC FE assemblies** were delivered.



Both graphs show the **NSF budget allocation**. In the case of the overall plan, the cumulative allocation is the allocation actually provided by NSF plus the planned allocations in FY10 to FY12. For the **FY10 graph**, the allocation is the planned FY10 allocation of 42.76 M$. The actual costs shown are the inception to date expenses for the bilateral project, as booked in the general ledger. These costs do not include the commitments. The FY10 graph shows that expense remains below the total available allocation.



OFFICE OF CHILEAN AFFAIRS (OCA): **One expatriate arrived** (Lewis Ball, ALMA Deputy Director). OCA has reviewed and signed a total of **12 new ALMA Local Staff Member contracts in the quarter**, bringing the total number of employees for which OCA provides ALMA with legal, payroll and travel support to **225 local staff**. Of these staff, 25 are assigned exclusively for AUI/NRAO activities. It was agreed that **AUI's local employment of local staff be reviewed after three years** to evaluate its compliance with Chilean legal matters, the cost efficiency of its operations, and responsiveness to programmatic requirements. This review was conducted 1-3 September 2010 and concluded "… overall that AUI has met the legal requirements for employing staff in Chile under the law that governs international observatories; established an effective, professional HR organization in Chile; hired over 80 local staff members; complied with existing management agreements among AUI, ESO, NAOJ, and the JAO; and successfully negotiated a three-year collective bargaining agreement with the newly formed employees' union. The committee compliments AUI on these successes..." The committee identified a number of issues that remain to be resolved and other issues that ALMA will face as it continues to grow and make the transition from construction to operations. The committee presented 20 recommendations for follow-up action.

OCA was heavily involved in the **union negotiations** that ended successfully with the signature of the final offer for a 3-year period on 12 August 2010.

Although in May 2010 a new OCA office space was found, subsequent visits to it revealed flaws in the design and restrictions in building and electrical installations that lead to **cancelling this as a viable option**. The problems found were: (a) leaky roof with HVAC equipment affected by the earthquake;

this situation was fixed by the landlord, however while doing so other problems became apparent: (b) the total area subject to the rent agreement was not all constructible as it was common property and that in order to use it required performing a rental procedure that would be on the edge of legality with respect to Municipal law. And finally, (c) the other renters of the building made us aware that the electrical connection to the floor was underspecified for a floor of our size, which we confirmed, requiring an upgrade from the electrical company. A **new office building was found in the area** (293 square meters in area, ~700 meters away from the new ALMA Santiago Central Offices), and negotiations are under way. **Outfitting will occur during in Q1/Q2 FY2011**.

OCA has provided the legal and institutional support for contracts and procurements for ALMA as follows: a total of **120 purchase orders were made for ALMA Construction (941 k$)** and **194 for ALMA Operations (JAO) (869 k$)**. The activities for ALMA Construction involve those described in the Site IPT section, namely AOS Roads Construction Contract, AOS Utilities – Electrical and FO cables installation contract, Fiber Optic Cable supply and Contractors' Camp expansion (JAO activity). Monthly reports were issued to CONAMA (environmental authority) related to flora/fauna and archaeological follow-ups. The **termination of the AOS Utilities – Electrical and FO cables installation contract** involved additional activities required to legally close the contract and follow-up.

ALMA Science Operations (SPO-8) Significant Events

- ***Science Operations***
  - ***Staffing***
    - xxx
  - ***Hardware and Software***
    - xxx
  - ***Workshops and Meetings***
    - xxx

Provided by: C. Lonsdale/J. Hibbard

Staffing: **Two of the three open user support scientist positions were filled**. Scott Schnee of the Herzberg Institute, Victoria, Canada, will fill a NAASC user support scientist position, October 1 2010 (Assistant Scientist/Astronomer). Adam Leroy, currently a Hubble Fellow at NRAO, will fill a NAASC user support position, March 1 2011 (Assistant Astronomer).

Hardware and Software: The first NA ALMA Mirror **archive racks and Oracle database** servers were installed and improvements to the archive room cooling system were completed. An instance of the **ALMA helpdesk was deployed** in preparation for integrated testing of the observation planning software, and it was configured for Single Sign-On. Integrated tests of the **observation planning software**, from Helpdesk questions through to technical assessments and mock proposal review meetings were performed together with the JAO and the other ARCs. **Pipeline Heuristics User Test 6 and tests of CASA updates** were completed.

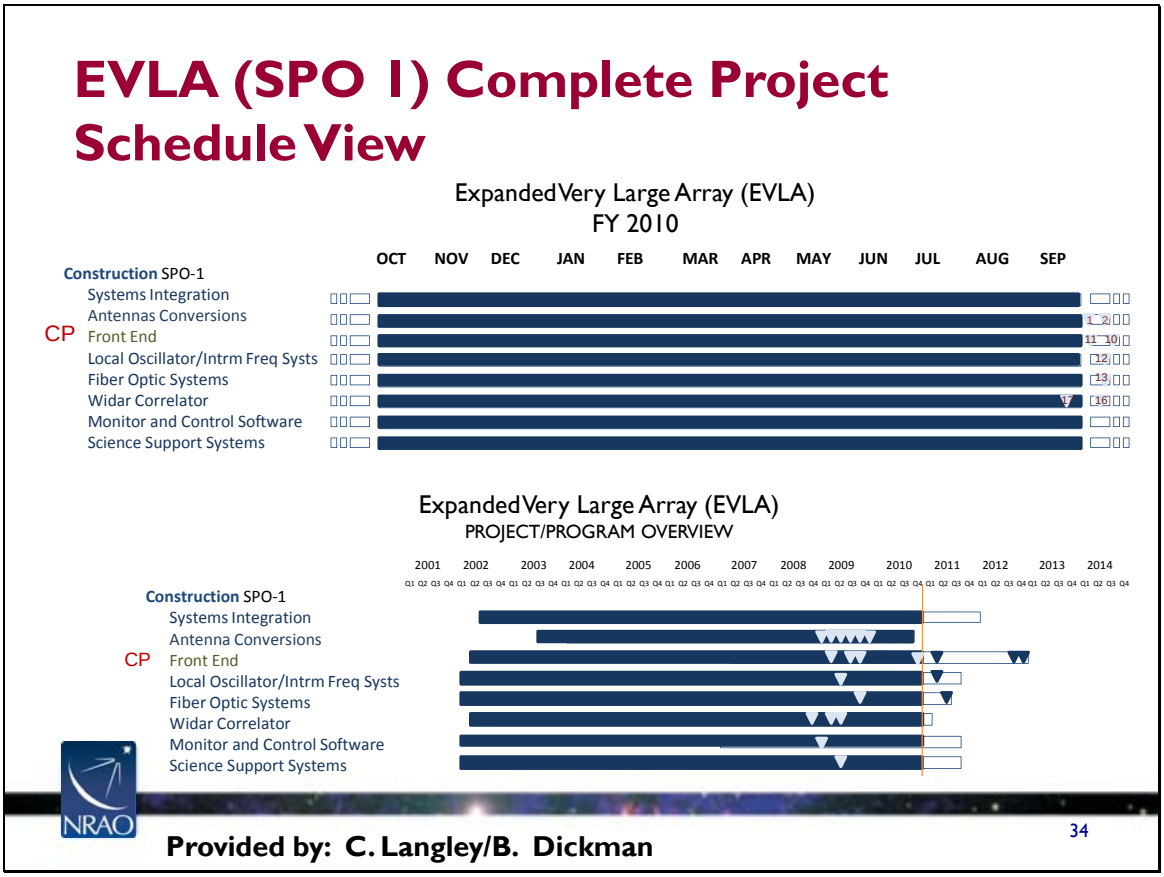
Workshops and Meetings: A special session, "**Preparing for ALMA", was held at the May AAS meeting** and a session on Observing with ALMA was scheduled for the January 2011 AAS meeting in Seattle. Several **data reduction and Simdata guides were developed for CASAguides** in preparation for the NRAO Synthesis Imaging School. **CASA and Simdata tutorials and Observing tool and Splatalogue walkthroughs** were given at the NRAO Synthesis Imaging School, and an ALMA Townhall was held.

Agenda

- Science Results/Metrics
- Observatory Science Operations
- Site Specific Activities
  - ALMA
  - VLA/EVLA
  - GBT
  - VLBA
- Observatory-wide Operations

Expanded Very Large Array (EVLA)

- The content was provided by
  - EVLA project Team
  - NRAO Business Services
- VLA and EVLA project tracked and presented to NSF through SPO 1



Status, Sept 30, 2010:

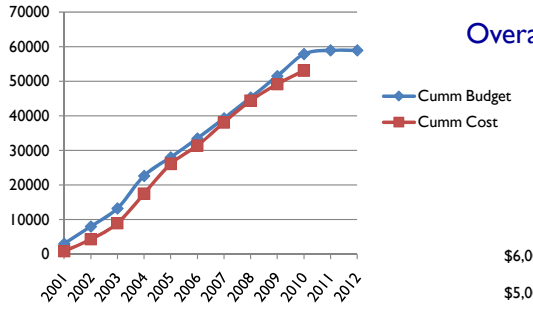
Slide reflects:

Milestones 17 has been satisfied

Milestones 10, 11, 13 and 16 have been slightly delayed.

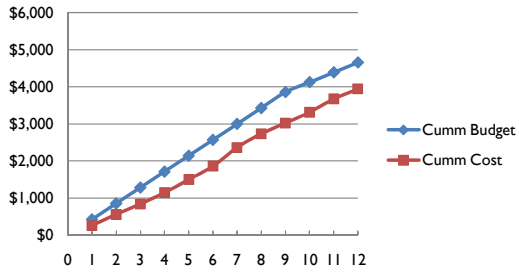
The bottom graph illustrates the full lifecycle. The top graph is this fiscal year view. The vertical line represents where we are today. The CP represents the critical path.

EVLA Construction Financial Performance Graphs – overall & Q4



Overall Spending for the EVLA Project

FY10 Budget/costs for EVLA Project



Provided by: C. Langley / B. Dickman

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Spending in FY10 is slightly behind schedule due to the delayed deployment of X-band receivers ($205K) and 3-bit sampler modules ($317K).

Financials are reported through September 2010. The FY10 graph is different from that in the Q1 report due to an error in fiscal reporting for Q1.

The FY10 budget/cost figure shows funds allocated for expenditure in FY10, only. Additional funds are on hand, but they are assigned to project activities, such as receiver production and installation, to be completed in FY11 and FY12 and to the retirement of project risk. The amount of these additional funds currently totals about $2M.

EVLA Construction Specific Milestones

- ***Systems Integration***
  - The System Integration WBS is complete, apart from minor support tasks.
- ***Antenna***
  - Installation of X-band (8-12 GHz) feed horns is ongoing [1]*
  - Fabrication of Ku-band (12-18 GHz) feed horns is ongoing [2]
- ***Front End***
  - Production and installation of EVLA Q-band (40-50 GHz) receivers are on track for completion by October 2010 [11]
    - An urgent need to repair VLBA Q-band receivers has delayed finishing the last receiver build
  - Installation of last two (27 & 28) Ka-band (26-40 GHz) receivers will be completed in Q1 FY 2011 [10]
    - Testing of solar mode capabilities for L and Ku-band has caused some delay with finishing the last few Ka-band receiver builds
  - Production and installation of other EVLA receivers continues.

NRAO

Provided by: C. Langley/B. Dickman

*refers to milestone number 36

The installation of the X-band horns exceeds the rate of receiver installations.

The time required to select the OMT design for the X-band receiver delayed its deployment start date to August 2010. However, the production and installation of the receivers are still scheduled for completion in December 2012.

Other EVLA receivers include L- (1-2 GHz), S- (2-4 GHz), and C-bands (4-8 GHz).

Impact of late Ka-band Rx should be slight since only 27 antennas/receivers can be used at a time. The 27th Rx to be installed in Dec; 28th Rx to be installed in Feb 2011.

EVLA Construction Specific Milestones

- ***LO/IF***
  - Compliant updates to specific modules are on track for completion by Q2 FY11 [12]
- ***Fiber Optic***
  - Evaluation of 3-bit, 4Gsps sampler prototype on 4 antennas has started
    - First delivery of production boards expected in December
    - Routine installation in antennas to start in January 2011 [13]
    - Testing of the 3-bit sampler prototypes proved more of a challenge than anticipated – more focus applied to several small issues.
    - Deployment to be completed on schedule (orig. September 2011)
  - Data Transmission System (DTS) test rack on schedule to be completed Q1FY 2011
    - Allows for simultaneous testing of 4 transmitter – receiver module pairs

Provided by: C. Langley/B. Dickman

The late deployment of the 3-bit, 4Gsps samplers has delayed the availability of 8GHz observing capability, but it does not delay the overall completion of the EVLA project.

EVLA Construction Specific Milestones

- ***WIDAR Correlator***
  - Circuit board production
    - Delivery of remaining 44 baseline boards are complete [17]
      - 44 boards are not needed for early science observations
  - Correlator "Acceptance Plan" to be finalized in Q2 FY 2011 [16]
    - Details of "acceptance" require more examination to better define goals with the plan
    - General user observations with WIDAR continue
- ***Monitor and Control***
  - Integration of WIDAR correlator with the EVLA M&C System continues
  - Computing nodes population ongoing as correlator capabilities advance
- ***Science Support Systems***
  - Continued use of Observations Preparation Tool (OPT) for OSRO
    - Use of the OPT for more advanced set-ups undergoing tests by Resident Shared Risk Observers and NRAO staff
  - Operations testing of Observation Scheduling Tool (OST) in preparation for full-time OST use for all observing, Q2 FY 2011

Provided by: C. Langley/B. Dickman

WIDAR baseline boards:

Final four baseline boards were delivered in September, 2010.

EVLA Science Operations Significant Events

- ***EVLA Data Access***
  - Access to OSRO EVLA data via an Archive Access Tool and ftp enabled in Q1 and Q2; further enhancements in data access speed in Q4
  - Planning for the dissemination of large datasets began in Q4 in preparation for the next bandwidth increase to be offered for OSRO, a model for data distribution will be tested with RSRO data in FY 2011
- ***Shared Risk Observing***
  - Open Shared Risk Observing (OSRO) began March 2010
  - The Resident Shared Risk Observing (RSRO) program began January 2010, continuing with an average of 6-7 participants in residence at any time
  - Observing for the RSRO program (16 correlator sub-bands) began July 2010
  - D configuration was extended to accommodate RSRO science observing; moved from D to DnC config in September

Provided by: C. Chandler/B. Dickman

EVLA Data Access: Dataset sizes obtained through the Open Shared Risk Observing program are up to an order of magnitude larger than any obtained previously be the VLA. These are currently being made available to the user community through an Archive Access Tool and ftp, via a fast 1 Gbps link from the Domenici Science Operations Center to the Internet-2 hub in Albuquerque. Further improvements in the way archive queries are handled have increased the speed of data access during Q4. While in theory the 1 Gbps link will have the bandwidth to support ftp downloads of future wideband data (in mid-2011 the data rates will increase by another order of magnitude), in practice the speed with which users can download data will probably be limited by general network traffic and the link speed at the recipient's end. We have therefore begun planning an alternative model for the dissemination of large datasets, involving the shipping of hard drives to users upon request. This model will be tested with Resident Shared Risk Observing data during FY 2011.

Shared Risk Observing: Access to the EVLA Early Science is provided by two shared risk observing programs for the user community: the Open Shared Risk Observing (OSRO) program, and the Resident Shared Risk Observing (RSRO) program, along with one for EVLA Commissioning Staff Observing (ECSO). OSRO projects have comprised the majority of observing time on the EVLA. RSRO observations with 16 correlator sub-bands began in July. The D-configuration was extended to accommodate wideband science. The move to the DnC hybrid configuration took place in September.

EVLA Science Operations Significant Events

- ***EVLA Commissioning and Science Verification (ECSV)***
  - Commissioning of overall system stability continued during Q4, data quality continues to improve
  - The Observation Preparation Tool was expanded to incorporate RSRO observing modes in Q4
  - The VLA's 74 MHz dipoles were installed and tested prior to the proposal deadline, Q4
- ***Proposal Submission***
  - The Proposal Submission Tool and EVLA user documentation was updated to support the September 15 Call for Proposals (proposal submission deadline October 1)
- ***Panel to Advise on Science and EVLA Operations (PASEO)***
  - The PASEO met in July to advise on EVLA construction, commissioning, and science operations

Provided by: C. Chandler/B. Dickman

EVLA Commissioning and Science Verification: The commissioning effort in Q3 focused on (1) improving overall system stability, (2) testing and verifying the new RSRO wideband observing modes and science data, and (3) testing the performance of the VLA's 74 MHz dipoles with the wideband EVLA electronics in preparation for the September 15 Call for Proposals.

Proposal Submission: The Proposal Submission Tool and the EVLA Observational Status Summary were updated to support the September 15 Call for Proposals, which included a special call to use the VLA's 74 MHz system.

PASEO: In July NM Operations hosted the first meeting of the Panel to Advise on Science and EVLA Operations in Socorro. The recommendations of this committee will be taken under advisement and implemented as appropriate.

VLA Operations Significant Events

- ***ARRA Funds use***
  - Purchase track repair materials: tamper, tie puller, and spiker: complete
  - Repair VSQ sprinkler system [Q4]: NSF has approved use of these funds to retire the VSQs from use; demolition work begins Q1 FY2011
  - Purchase azimuth bearings, transformer, and spare dry-type transformers: complete
  - Purchase buses: complete
- ***Computer Infrastructure***
  - Upgrade DSOC-Internet2 link to 1 Gbps [Q1]: complete
  - Install 60 TB capacity, 3 GB/s Lustre file system [Q4]: complete
- ***Engineering Services***
  - Moved into D array [Q1], and to DnC [Q4]
  - Replaced az. gear boxes on antennas #6[Q3], #7[Q4]; az. bearing on #6[Q3]
  - 5000 ties will be replaced along the ~ 44 miles of array tracks [Q4]
    - 3000 ties replaced and 9 intersections repaired [Q4]: complete
  - Reconfiguration into C- and B-configurations [Q2, Q4] – delayed to FY11

Provided by: P. Perley/B. Dickman

ARRA funds use: VSQ sprinkler replacement is to be replaced by retirement of VSQs as a result of mouse infestation. NSF approved alternate use of these funds in Q4.

Management, Facilities, Telescope Operations, Hardware, and Software are covered under the EVLA sections.

Computer Infrastructure: NRAO internal work has been completed for this milestone. However, New Mexico Tech was having trouble providing promised connectivity to Internet 2 at full 1 Gbps bandwidth. This problem was resolved in April 2010.

Engineering Services: Ongoing work items include 5000 ties being replaced along the ~44 miles of array tracks by the end of Q4. Only 3000 completed by Q4 due to additional work need to repair intersections and the wait for tie delivery (used ARRA funds and no ties ordered in previous FY). The planned azimuth bearing change on antenna #25 was performed on antenna #6 instead, to coordinate with the repair of its azimuth gear box. Antenna #25 will have its azimuth bearing changed at a later date.

The reconfigurations into C- and B-configurations have been moved to FY2011. RISK: none; no impact on EVLA schedule.

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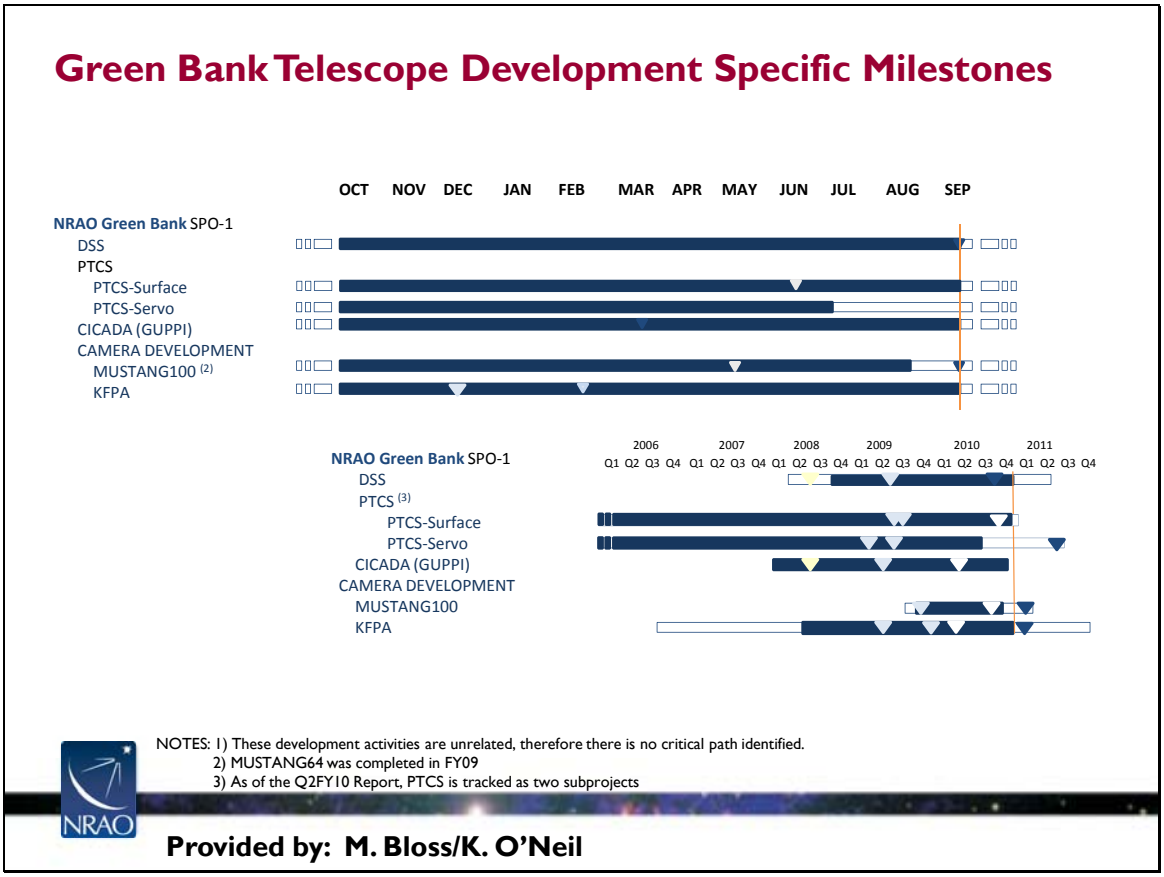


DSS: Work continues on interim enhancement releases and the next major capabilities release in early Q1FY11 (2-week delay). Software effort this quarter was devoted to the completion of our scheduling algorithm infrastructure expansion and addition of a sensitivity calculator.

PTCS: NOTE: Beginning Q2FY10, for clarity, PTCS is tracked on this page as two sub-projects

PTCS-Surface: The surface RMS goals for the GBT main reflector in benign conditions was met in Q3FY10. All holography maps to date have been re-processed with an improved formula for the correlated amplitude. This is expected to yield a slightly improved surface, and verification tests with Mustang are planned in Q1FY11.

PTCS-Servo: Acceptance testing for the digital servo has been rescheduled for Q4FY11 due to operational calls on project personnel. Risk: Advanced modeling for servo is delayed, additional operational funds will be required once the Lockheed/Martin funds are depleted to finish the project. Mitigation: The schedule to begin work on model-based servo control will be delayed.

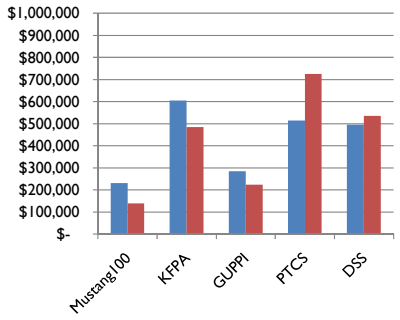
CICADA (GUPPI): The planned initial release of the GUPPI de-dispersion modes has been completed. Release of additional modes and ease-of-use improvements will now be managed through routine Green Bank instrument enhancement protocols.

Camera Development:

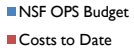
MUSTANG100: For FY10 we have established the MUSTANG100 project to track the potential upgrade to a 100-pixel array in the existing MUSTANG receiver. The delivery of a new array by

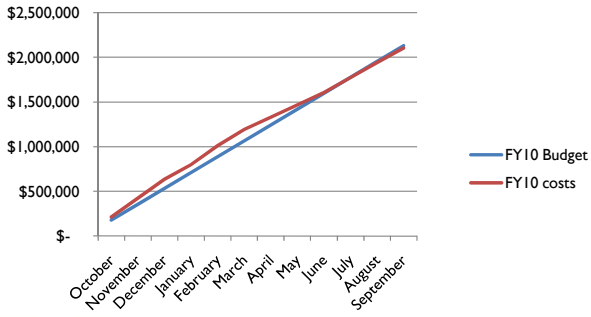
NIST occurred in Q4FY10 as rescheduled but a wirebonding issue compromised the first test run.. Risk: MUSTANG100 will not be ready for the upcoming high frequency observing season. Mitigation: Use Mustang 64 for the early part of the season. Note: The schedule for the 100-pixel array is in NIST, not NRAO control (NIST is donating the array).
KFPA: Final commissioning prior to shared risk observing in Q1FY11 was successful.
Note: In the Program Operating Plan, the milestones #7 and #8 were reversed. Mustang 64 was released for general use in Q1FY10; KFPA commissioning begins in Q2FY10

GBT Overall Development Financial Performance Graphs



FY 2010 Spending for the GBT Development Projects





FY2010 Spending for GBT Development

Provided by: M. Bloss/K. O'Neil

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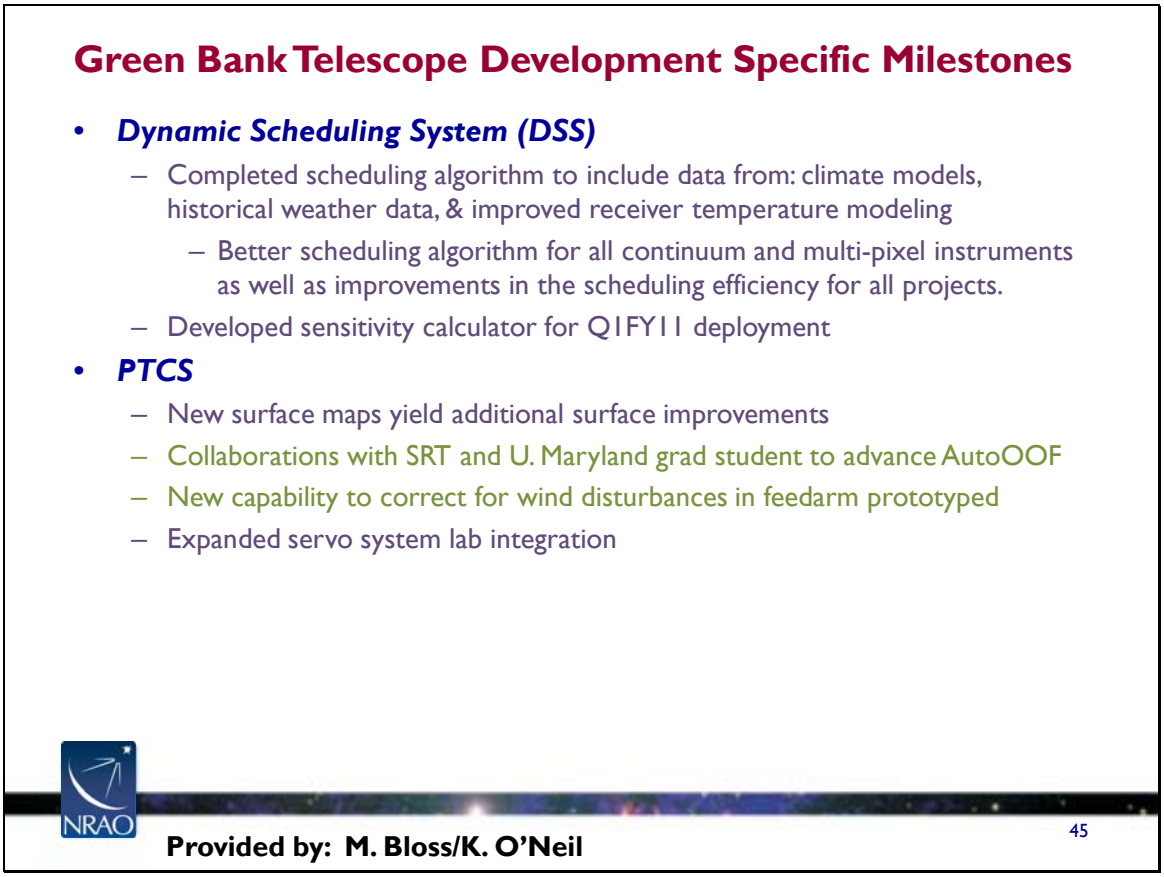
Overall development expenses for Green Bank tracked the budget very closely for FY10. The **DSS** project finished the year 8% over budget due to additional contract labor added to keep the project on schedule while key vacant positions were in recruitment. **PTCS** was 41% over budget due to 1) overlap of scientists as Todd completed the surface work, transitioning off to ALMA slower than projected, 2) addition of a new project scientist to the project and, 3) the unbudgeted extensive use of two technicians to built multiple prototype motor interface cards for the PTCS servo project. However, due to lower expenses than projected for the other projects, the Green Bank development expenses finished 1% under budget at the close of Q4FY10.

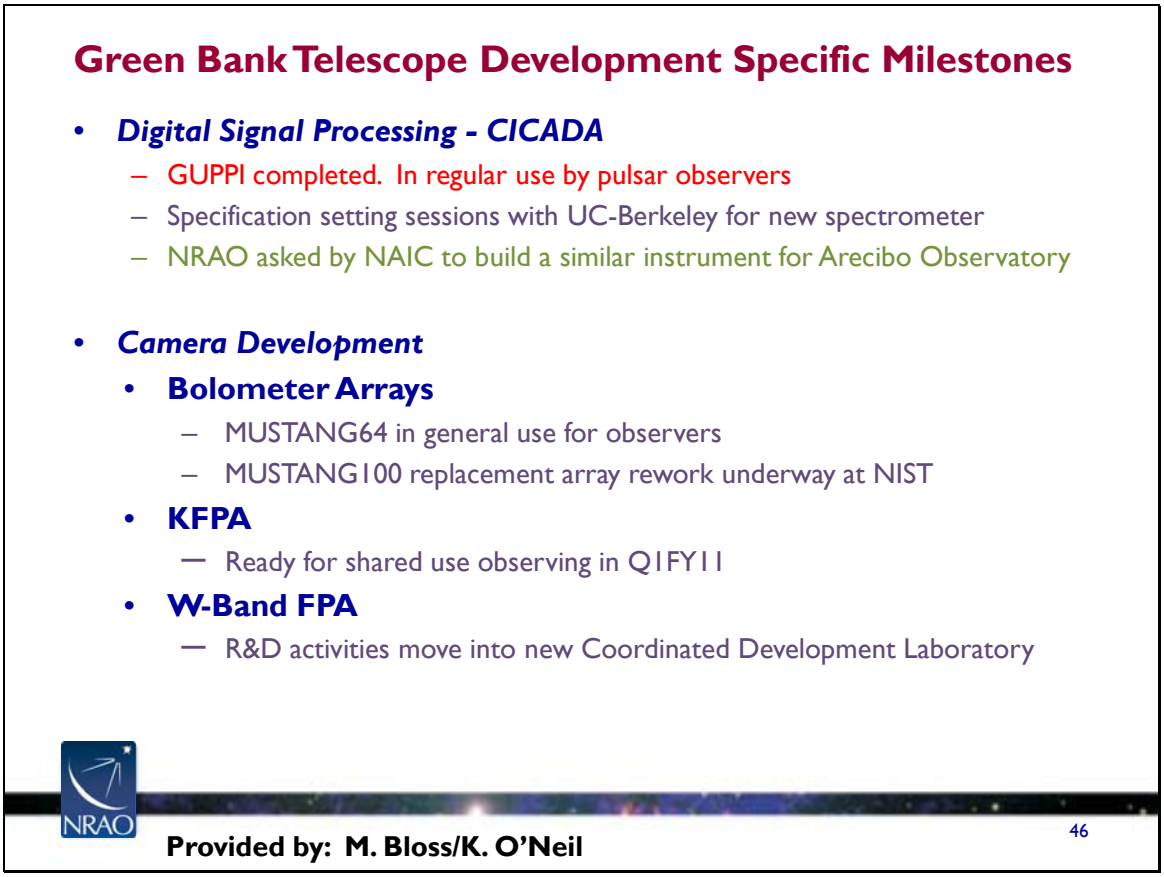


DSS:
A large portion of the software effort this quarter was devoted to completing the scheduling algorithm infrastructure to include hooks for climate models, usage of historical weather data, and more realistic modeling of receiver temperatures. These expanded capabilities will be released early in Q1FY11, immediately benefiting high-frequency observers. A sensitivity calculator, which will assist astronomers in determining observation durations based upon science objectives, was also developed and is expected to be completed next quarter. This tool will ultimately be available to astronomers as part of the proposal creation and submission process to streamline proposal preparation. Likewise, we expect this tool to make the technical review process simpler as well.

PTCS:
Surface: All holography maps to date have been reprocessed with an improved formula for the correlated amplitude. This should yield a slightly improved surface, and tests with Mustang are pending in the next quarter. Work continued on the GBT memo on surface panel deformations, comparing manufacturer predictions with holography measurements under different environmental conditions. The group has begun assisting the Sardinia Radio Telescope (SRT) group in their initial attempts at commissioning their holography system. Using effort provided by the SRT and a U. Maryland graduate student (funded by AUI), we have started a new round of "out-of-focus" (OOF) holography data processing improvements.
Pointing: Measurements completed on July 1&2 and confirmed successful completion of the track project; published pointing corrections and required updating of pointing model are delayed due to change in PTCS staff. GB staff has developed a prototype system to use the Subreflector to correct for the effects

of pointing due to wind-induced deflections of the feedarm. This approach appears extremely promising, and will be converted into a production system as software resources become available.

Servo: Much of the activity on the PTCS servo system in the quarter surrounds the integration of the EtherCat control protocol into the servo lab's GBT motor simulator; which provides an environment to drive all of the simulated elevation and azimuth motors from the new digital servo control systems. All integration work for the servo subsystems will be tested on this environment before they are released for the GBT. Installation of servo hardware begins in Q1FY11 but due to staff members diverted to work on other important operational issues and unscheduled telescope maintenance the completion and acceptance testing schedule are delayed. The POP calls for the replacement of the current servo system with a digital system by the end of Q4, however this deployment is now delayed until Q4 FY2011. Risk: Advanced modeling for servo is delayed, additional operational funds will be required once Lockheed/Martin funds are depleted. Mitigation: None. Risk will be assumed. The performance at the various milestones is meeting spec and expectations while the schedule to achieve the associated milestones slips. The PTCS work is so fundamental to the GBT strategic future, it must be completed, even if operational funds are required.



CICADA:
GUPPI: The planned initial release of the **GUPPI** de-dispersion modes has been completed. Release of additional modes and ongoing ease-of-use improvements will now be managed through routine Green Bank instrument enhancement protocols.
SPECTROMETER: **The GB spectrometer ATI grant** through UC-Berkeley has been funded. A project kickoff meeting was held on September 2, 2010 establishing a baseline set of milestones, action plan for the project, and initial specifications. NRAO and UC-Berkeley are in ongoing dialog to refine the specifications in accordance with the design phase as described in the ATI proposal.
NAIC PULSAR BACKEND: NRAO has agreed to build a version of its GUPPI **pulsar backend for the Arecibo telescope** in Puerto Rico. With a minimum amount of Green Bank effort, the Arecibo Observatory is able to leverage the significant work by NRAO and the Berkeley CASPER group for an affordable world-class backend to use in science related to timing microsecond pulsars and nanograv experiments.

CAMERA DEVELOPMENT:
MUSTANG100: **MUSTANG64** on the GBT and in use for regular observations, closing out that project. Per the POP, the array for this instrument will be replaced with a 100-pixel array produced by the National Institute of Standards and Technology (NIST). NIST completed a **100 pixel detector array**, using results from U.Penn's witness pixel measurements earlier in the summer, and installed it in the array package. A wirebonding issue, now being addressed, compromised the first test run. With the 90 GHz observing season imminent and a heavy proposal load, the original 64 pixel array was reinstalled and 100 pixel retesting will occur later in the season.

KFPA: The **KFPA receiver** received modifications to the cryogenics between commissioning runs reducing the amplifier physical temperature so the system temperatures for the receiver are comparable to the EVLA K band receivers and below the 35 K maximum specified system temperatures. The investigation into some spurs was complete and Config Tool requirements modified to reflect the LO settings required to mitigate any in-band spurs. All observing modes were tested and each of the seven beam calibrated. Integration into the GBT observing systems prepares the receiver for the shared risk observing call for Q1FY11. Testing and documentation of the **KFPA Python data reduction pipeline** nears completion and position switched data reduction has been completely tested from observation planning, observation and automatic data reduction by a number of test observers.

W-Band FPA: Work progresses toward **a conceptual design of the W-Band FPA receiver**. Oversight of the R&D aspects of this work will be transferred in Q1FY11 out of the Green Bank Development auspices into the Coordinated Design Laboratory in Charlottesville.

Green Bank Science Projects Specific Milestones

- 4mm Two-pixel receiver conceptual design review completed
- Ka correlation receiver with new hybrids under test on GBT
- 20m Telescope and receiver rehabilitation begins for UNC SkyNet collaboration
- Initial GBT VLBI code completed in anticipation of new hardware

Provided by: M. Bloss/K. O'Neil

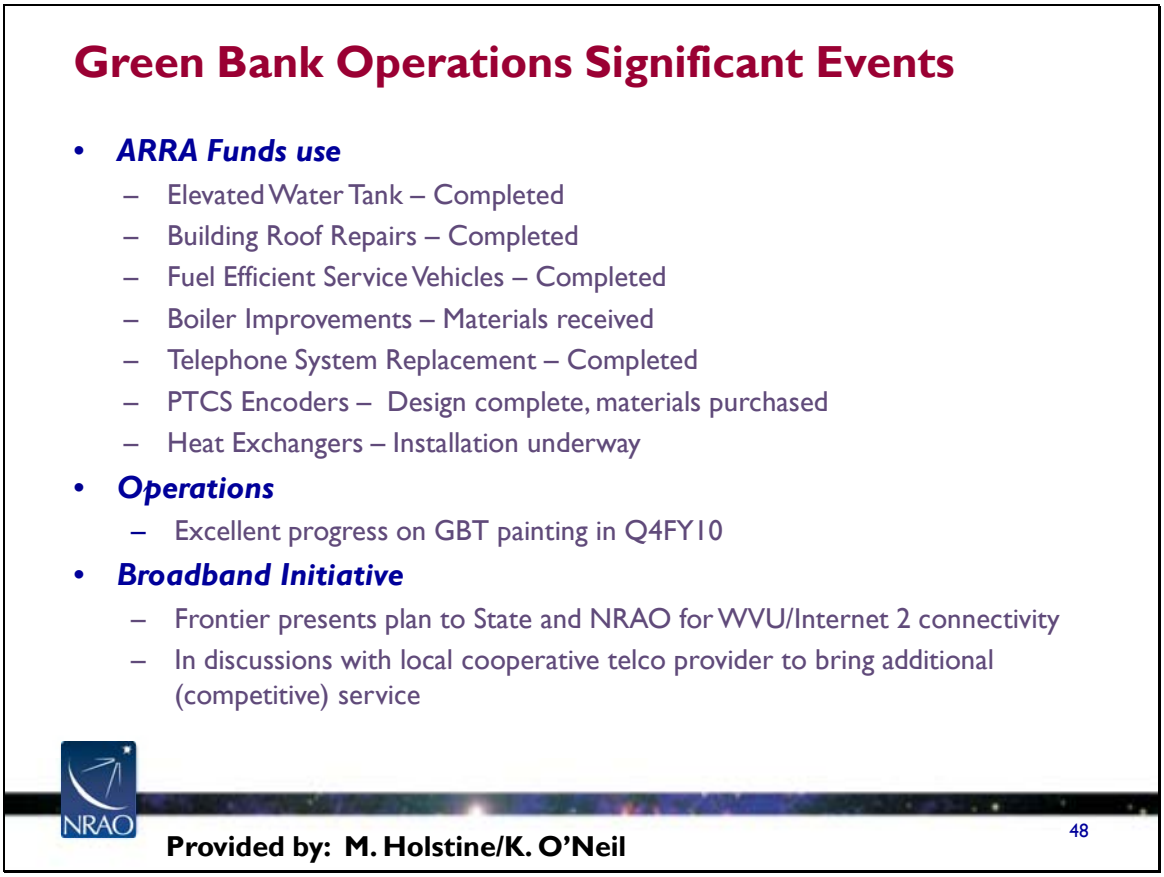
A core team of scientists and engineers presented the design concepts for **the 4mm Two-pixel receiver** to a joint meeting of Green Bank and CDL management and staff. The conceptual designs were validated with the primary unresolved issue being the need for a cold isolator. To mitigate the risk of this unresolved element, the team has devised a plan to build a single pixel RF thread in the production dewar and perform baseline stability and polarization purity measurements to determine if the planned design requires the additional components.

New hybrids were installed in the **Ka correlation receiver** and the receiver was reinstalled on the GBT in Q4FY10 for Zpectrometer, Spectrometer, and Continuum backend characterizations. Initial results show baseline improvements since the rehabilitation. Once final characterization with the various backends is complete, Ka observers will be notified of the new performance limits and be invited to reinstate their projects.

Work has begun on rehabilitation of the **20m telescope** in Green Bank and two receivers; L-Band and X-Band. The frequency coverage of the L-Band receiver will be expanded to match the science requirements of the SkyNet project and NRAO will place the X-Band components in a new dewar for the better long-term cryogenic performance required of the **SkyNet** project.

Work continues on the **GBT VLBI Upgrade** with as much of the first round coding that could be started without the recorder complete and ready for testing. The Roach Digital Bank End is being returned to Socorro for reprogramming and will require some interface adjustments when it is returned. Two Green Bank staff will travel to Socorro in early Q1FY11for implementation meetings

Work continues on data reduction and mining software to **streamline publication of GBT data** and science results.



In accordance with the rules for expenditures of stimulus funds, all parts and materials were purchased in Q4FY10 for all of the projects funded by the American Recovery and Reinvestment Act (**ARRA**). Four projects are complete and materials purchased for all others.

With additional painters contracted and generally cooperative weather this quarter, a greater portion of the **GBT was painted** than in earlier years. This is part of a multi-year increase in painting effort to bring the GBT into compliance with outside engineering consultant's recommendations for maintenance. Several surface panels were painted and then re-measured to verify that they remained within surface thickness specifications.

Frontier Communications has proposed to the State of WV and NRAO a path for a **broadband connection to WVU** which will ultimately connect to Internet 2 and/or LambdaRail. Technical capabilities will be reviewed with the stakeholders in Q1FY11. Direct contact has also been made by NRAO with a second provider to evaluate alternative service options as a competitive and risk-reducing strategy.

Agenda

- Science Results/Metrics
- Observatory Science Operations
- Site Specific Activities
  - ALMA
  - VLA/EVLA
  - GBT
  - VLBA
- Observatory-wide Operations

VLBA Development Significant Events

- ***Sensitivity Upgrade***
  - Initial electronic connections made to the Pie Town and Mauna Kea VLBA antennas [Q4]:
    - delayed pending signing of the NRAO-USNO MoU for funding the fiber link
  - Trial installation of DBE/MK5C at Pie Town and Los Alamos [Q2]:
    - the order of DBE/MK5C installations was changed to accommodate track work on the PT antenna. The following antennas were outfitted with DBE/MK5C units: Los Alamos [Q3], Hancock [Q4], Pie Town [Q4], Mauna Kea [Q4]; recording at 2 Gbps has been demonstrated [Q4]
  - Design and production of all DBE support hardware [Q3]:
    - design complete, production in progress to support DBE/MK5C installation schedule

Provided by: W. Brisken/B. Dickman

Sensitivity Upgrade: Work on the fiber links to the PT and MK VLBA antennas was delayed by the delayed signing of the NRAO-USNO Memorandum of Understanding, which is providing the funding for this upgrade. The MoU was signed in Q4.

The trial installation of DBEs at Pie Town and Los Alamos were not met in Q2 due to collaborator delays (Haystack). The order of DBE/MK5 installations was modified to accommodate emergency maintenance work on the Pie Town antenna. By the end of FY 2010 four antennas were outfitted with the new recorder systems and recording at 2 Gbps has been demonstrated.

VLBA Development Significant Events

- ***New Receiver Systems***
  - Installation of full coverage C-band (4—8 GHz) VLBA receivers:
    - MRI proposal to NSF rejected; NSF encouraged submission of new MRI proposal [Q3], rejected [Q4]
    - It is hoped that a reallocation of ARRA funds originally intended for 33 GHz receivers can fund this upgrade
  - 33 GHz receivers will be designed, built, and installed on the VLBA;
    - The 33 GHz receivers will be built (using ARRA funds) if MoU between NSF and USNO is signed
      - Pending NSF approval
- ***MRI-R2 NSF Proposal – Acquisition of Recording Media to Triple Sensitivity of the VLBA***
  - Began purchase of 8TB disk packs with MRI grant to support 512 Mbps sustained operations [Q4], to be completed Q2 FY 2011
    - Problems with modules, vendor to address the problem; delivery now expected Q1 FY2011

Provided by: W. Brisken/B. Dickman

33 GHz receivers will be designed, built, and installed on the VLBA using ARRA funds if the MoU with NSF and USNO is signed.

8TB modules purchased have been unusable due to a firmware bug. Conduant Corportation will address this. Estimated entry into service of these 8 TB modules is Oct 20, 2010.

VLBA Operations Significant Events

- ***ARRA Funds use***
  - ARRA Funds were intended to be used to design and build 33 GHz receivers for the VLBA, pending signing of MoU with NASA and USNO. It is unlikely this MoU will be signed, and we await approval to use these funds to build the 4—8 GHz receivers instead
- ***Partnerships***
  - As of end Q4 NASA had not signed the MoU to provide operating funds for the VLBA; USNO has sign an MoU, effective for 5 years beginning Q1 FY2012 (NSF signature still pending)
  - USNO and NRAO have signed an agreement for funding installation of fiber links to PT andMK; will enable USNO to compute UT1—UTC with much reduced latency
- ***Engineering Services***
  - Four VLBA stations received major maintenance visits by the VLBA Tiger Team: Mauna Kea [Q1]; Hancock [Q2]; Fort Davis [Q3]; Brewster [Q4]
  - Engineering and painting visit to Saint Croix [Q3]: completed
  - Azimuth track repaired at Brewster, North Liberty and Hancock [Q4]: completed
  - Azimuth rail failure at PT: weld repair completed, additional segments purchased [Q4]
- ***Hardware***
  - Install security systems at HN,OV, NL, PT, BR, SC [Q3] – completed at OV, HN in Q1; PT, NL completed in Q3; BR, SC to be completed in Q1 FY2011

Provided by: P. Perley/W. Brisken/B. Dickman

Draft MoU completed and awaiting signature by NASA and USNO. Both agencies committed to the development of the MoU, but found that they did not actually have committed funding when it was time to sign.

Azimuth wheel replacement at Hancock required because old wheel broke January 3, 2010. Major maintenance on HN, originally scheduled for Q3, was performed at this same time to avoid an additional trip.

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  - Computer & Information Systems
  - Management & Administration Infrastructure

Central Development Laboratory (CDL) Development, Production & Repair/Maintenance

- ***Amplifier Production and Development***
  - Delivered 21 amplifiers to EVLA
  - Repaired, and retested 7 amplifiers for the EVLA
  - Evaluated and tested three prototypes of 230-470 MHz amplifier. The mechanical design of two production version is under way
- ***Electromagnetic Support***
  - Measured and evaluated EVLA X-band and Ku-band phase shifters

Provided by: J. Webber

Amplifier Production, Repair, and Development: Three prototypes of the P-band 230-470 MHz amplifier have been evaluated and tested. The mechanical design of the amplifier body of two production versions of the amplifier (they differ only by the hybrid used) is under way. Experimental evaluation of ALMA band #1 and #2 amplifiers awaits the availability of technician time. New amplifier production milestones included four 1-2 GHz, four 2-4 GHz amplifiers, four 8-18 GHz, and four 26-40 GHz amplifiers. Repair, upgrade, and retesting of amplifiers included one 1-2 GHz, two 8-18 GHz, four 18-26 GHz, one 26-40 GHz and four 38-50 GHz amplifiers. In total, 28 amplifiers were shipped. The EVLA amplifier production is slightly ahead of schedule. The deliveries of 18-26 GHz and 38-50 GHz amplifiers in support of MPI Receiver Group are on schedule.

Electromagnetic support: The Ku-band (12-18 GHz) phase shifters are scaled from Ka-band design; the X-band (8-12 GHz) is scaled from the W-band design. A total of 19 Ku-band and 2 X-band phase shifters were measured.

Central Development Laboratory (CDL) Research and Development

- ***Amplifier Research and Development***
  - Research into general noise properties of three-terminal active devices and in particular on noise properties of heterostructure bipolar transistors (HBTs) and CMOS MOSFET continues.
  - Measured improved noise temperature of 35nm W-band MMIC LNA at 8K operating temperature
  - Bryerton and Pospieszalski attended and gave talk at Bonn workshop on heterodyne receiver arrays
- ***Electromagnetic Support***
  - Measure and evaluate a S/X dichroic reflector for VLBA
  - Finalize design of X-band phase shifter for EVLA
  - Srikanth attended 2010 Asia Pacific Radio Science Conference in Toyama, Japan and presented a paper titled "Wideband Waveguide Phase Shifters".

Provided by: J. Webber

Amplifier Development: Research on general noise properties of three terminal active devices and in particular on noise properties of heterostructure bipolar transistors (HBTs), and CMOS MOSFET continues. A paper covering initial results has been published in IEEE Microwave Magazine (M.W. Pospieszalski, "Interpreting Transistor Noise," IEEE Microwave Magazine, vol. 11, no.6 pp. 61-69m Oct. 2010).

Using the THz SIS mixer test dewar, noise temperature improvement of the W-band 35nm MMIC LNA at lower ambient temperature was measured. Improvement of 4-6K in noise temperature was seen going from 17.5K to 8.5K ambient temperature, in agreement with theory. Bryerton gave a talk at Bonn *Receivers & Array Workshop* entitled "Cryogenic Performance of NGC 35nm InP Low-Noise Amplifier."

Electromagnetic Support: The S/X dichroic panel uses a ¼" Kevlar Honeycomb backing and lately this material is not available in small quantities. Aramid fiber honeycomb from Plascore Inc. was chosen as an alternate material after measurement and evaluation. One of two different designs of X-band phase shifter was chosen after measurements.

Central Development Laboratory (CDL) Research and Development (cont.)

- ***Millimeter & Submillimeter-Wave Receiver Development***
  - Optimization of processing parameters for Nb/Al-AlN/NbTiN junctions ongoing for 400-500 GHz SIS mixer
  - Fabricating Nb/AlN/Nb test junction with direct sputtered AlN
  - Refabricating 400-500 GHz superconducting hybrid on high-resistivity silicon
  - Completed the warm IF subsystem of the new THz mixer measurement system
  - Continuing design of 790-950 GHz SIS mixer

- ***Advanced Receiver Development***
  - The first cryogenic demonstration of a Digital Ortho-Mode Transducer (DOMT) is in the design stage at S-Band (1.7-2.6 GHz).
  - A provisional patent application has been filed on "Statistical Word Boundary Detection in Serialized Data Streams."

Provided by: J. Webber

Millimeter & Submillimeter-Wave Receiver Development: Initial set of 700um SIS circuits had too thin AlN barriers, and therefore too high current densities. We therefore have stepped back to optimize the processing parameters, specifically the nitridation growth time, in order to accurately produce junctions with the correct current density. Three test wafers with different nitridation times are in the final steps of fabrication. Progress has also been made in direct sputtering of the AlN barrier (as opposed to using nitridation of Al layer). This is expected to give more repeatable current densities and is a necessary step in producing the NbTiN/AlN/NbTiN junctions, needed for quantum-limited SIS mixers up to 1.4 THz. The loss of the 400-500 GHz superconducting Nb hybrid did not go away upon cooling as expected. The resistivity of the substrate is the suspected culprit. The hybrid is being refabricated on high-resistivity silicon. In the continuing design of a 790-950 GHz SIS mixer, a Matlab program was developed to calculate the surface impedance of a normal metal in the extreme anomalous limits and calculated surface impedance values for 787-950 GHz for Nb, NbTiN and Al.

Advanced Receiver Development: The first **cryogenic Digital Orthomode Transducer (DOMT)** is being designed for S-Band (1.7-2.6 GHz) and will include a common-mode coaxial input for field-calibration. It is hoped that eliminating the cal coupler and injecting the calibration signal instead into an orthogonal mode, as well as minimizing the path length from the feed to the cryogenic amplifiers, will lead to a small but nonetheless beneficial reduction in noise temperature over our best current systems.

A **provisional patent application**, "Statistical Word Boundary Detection in Serialized Data Streams," has been filed concerning the techniques we have developed to implement low-overhead digital photonic links between receiver arrays in the field and backend signal processing facilities. The first

hardware demonstration of this concept will be done using low-cost PCB's, for which the schematics are nearly complete and the layouts are in progress.

The **35nm MMIC LNAs** are in fabrication at Northrop Grumman. We expect delivery of chips for testing early next year (no bullet on slide).

Central Development Laboratory (CDL) Research and Development

- ***Phased Array Feed (collaboration with Brigham Young University)***
  - All 19 dual LNAs with thermal transitions mounted in cryostat
    - Thermal load measurements completed and design calculations verified
  - Sky noise measurements on single isolated dipole completed
    - Used dipole matched to LNA in absence of mutual coupling
    - Total noise in good agreement with calculations
  - Dipole designs for good noise match to LNAs in the presence of mutual coupling continues at BYU
  - Planning underway on next measurement campaign on the Green Bank 20-meter
  - 40 L-band analog fiber modems on order for RF links between GBT and Jansky lab
  - New, wider bandwidth receiver units were completed at BYU and shipped to Green Bank for installation.

Provided by: J.Webber

Phased Array Feed: Our BYU colleagues took our uncooled 19-element prototype array to Arecibo for tests on that telescope at Gregorian focus. These measurements will be of value in assessing the modified dipole for better noise match in the presence of mutual coupling. Our next measurement campaign on the 20-meter will include tests of both the uncooled array dipoles with better noise match and our first array with cooled LNAs. NRAO's new 40-channel data acquisition system with up to 5 Msa/s data streaming to disk will be used in these measurements.

Central Development Laboratory (CDL) Research and Development

- ***PAPER***
  - South African 32-element array
    - Completed second data run
  - Green Bank 32 element array
    - Completed 12 day data run for each polarization
    - Completed antenna rotation experiment.
    - Began array configuration study
  - Engineering experiments continue
    - Receiver gain and noise temperature corrections
    - Study of ionospheric effects on PAPER data

- **Broadband Active Feed**
  - Completed 300-3000 MHz ambient temperature version for the Green Bank 43m telescope
  - Assembled the 300-3000 MHz cryogenic version
    - A9dditional vacuum problems were corrected
    - Refrigerator vibration problems observed; cold strap re-engineered.
- ***LUNAR***
  - Developed a concept of the broadband dipole antenna and front-end electronics for the NASA Dark Ages Radio Explorer (DARE) mission proposal.

NRAO

Provided by: J. Webber

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The Precision Array to Probe the Epoch of Reionization (PAPER): Calibration of the 32 element Green Bank and South African arrays was completed. Data analysis is underway.
The engineering experiments such as the antenna rotation, receiver modeling, and study of ionospheric effects are graduate student projects.

Broadband Active Feed: The ambient temperature 300-3000 MHz feed is completed. Work continues on refinements of the cryogenic version.

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 front-end design concept.

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New Initiatives- Square Kilometer Array (SKA)

- ***SKA Program Office will increase its SKA effort from the recent level of 2.0 FTEs to 3.5 FTEs [Q4]***
  - NSPO effort will be 3.05 FTEs [2010 Q4]
  - FY11 effort will be 4.15 FTE.
- ***Develop the overall plan for the Dish Verification Program, including beginning the design of an implementation at the EVLA [Q4]***
  - DVA-1 engineers will meet at USSKA Consortium meeting 11-13 Oct
  - There is a DVA-1 CoDR scheduled for Jan 2011 to cover designs and plans for this program. Further decisions on DVA-1 will await successful completion of this milestone.
  - NRAO has agreed in principle to manage the DVA-1 (Chris Langley) should it proceed for construction. Agreement to this, including details and resources, will only occur after all necessary reviews and milestones are met.

Provided by: J. Ulvestad, S. Myers

NSPO 3.05 FTE in 2010 Q3 : Kellermann (1.0), Myers (0.25), Shepherd (0.9 with 0.5 paid by South Africa), Norrod (0.5), Webber (0.4 though has been spending most time on CDL/ALMA),

We have in principle agreed to manage the DVA-1 as a 3-part project: (1) producing a design for a SKA Prototype Antenna as a deliverable of the TDP to SPDO, culminating in a CoDR around or before March 1, 2011; (2) a costed preliminary design and plan for construction and testing of a DVA-1 antenna likely at the EVLA site; (3) assuming resources are identified, actual construction and testing of DVA-1. There are milestones between each step, with opportunity for re-assessment. The DVA-1 project management plan is being developed under the leadership of Chris Langley, who is targeted to take the role of DVA project manager assuming successful completion of the CoDR (and any other necessary design reviews).

The DVA-1 Conceptual Design Review (CoDR) is now scheduled for Jan 2011 in Socorro, NM. The outcome of this first review of TDP deliverables will determine whether we move forward to prototype construction under TDP funding.

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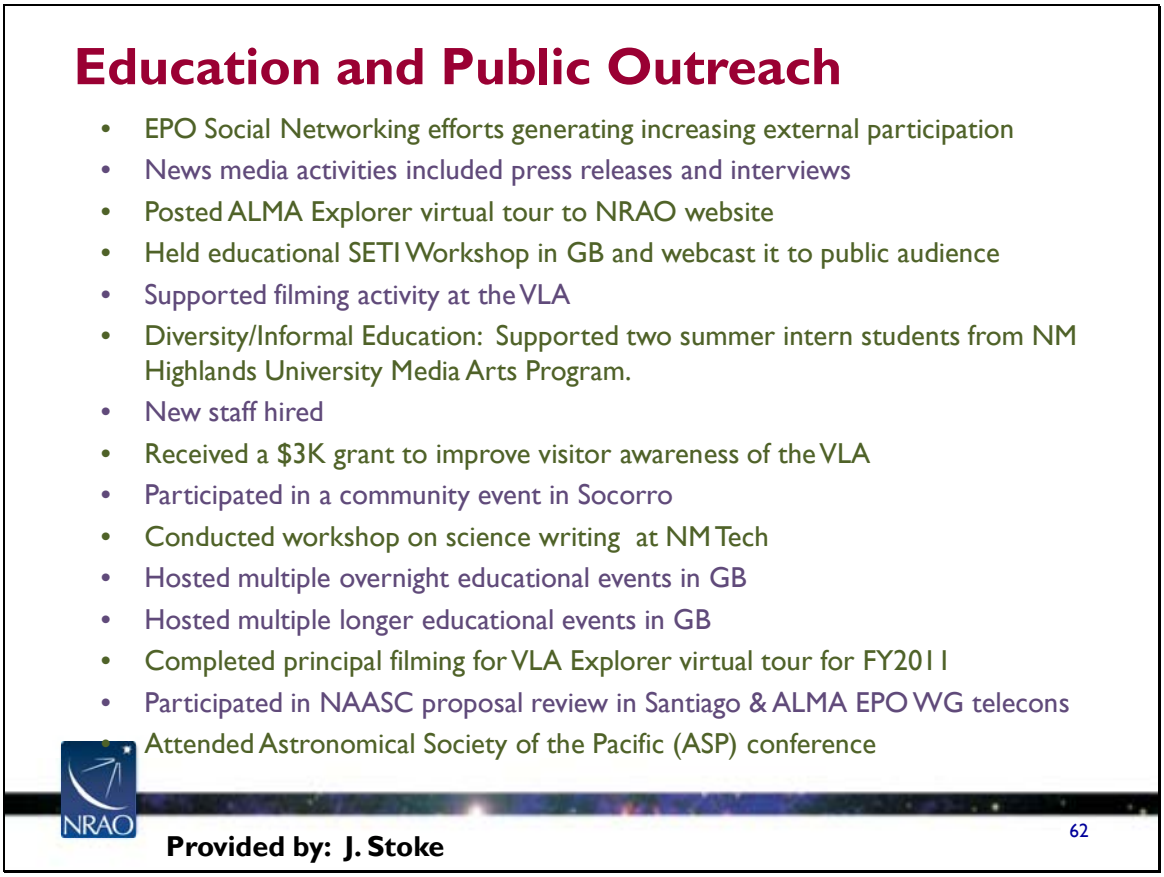

Social Networking

• NRAO's Facebook fan numbers increased by over 27% during this quarter, from 1800 to 2300.

• NRAO's tweets have been "re-tweeted" (by recipients) 97 times during this quarter, reaching roughly 33,000 people PLUS the many thousands of people following the #astronomy, #seti, #space, and #womeinscience hashtags when they were appropriately used. One tweet that "went viral" with re-tweets entailed our pointing to a nice ALMA EPO resource posted on the ESO website; this also demonstrates NRAO's commitment to fostering success of the international ALMA EPO effort. (No thanks received from ESO after we told them we did it…)

News Media Activities

• GBT intensity-mapping press release issued. Also directed several reporters to Chris Carilli for "independent commentary"

• Coordination with Chandra on Chandra/VLA release re 4C +00.58. (Changed spin axis of galaxy's SMBH)

• Coordination with Chandra on M87 "volcano" release

• SETI@50 press releases issued for GB public event and for Webcast of scientific workshop

• Interviews & coordination for Iowa Public Radio story on VLBA

• Prepared VLBA "talking points" memo for Walter Brisken radio interview

• Provided photos and information for upcoming (November) Popular Science item on ALMA, then did extensive interview with their fact-checker revising item

• Promoted VLA Open house and NRAO participation in M Mountain Fly-In during media interviews and at Socorro City Council meetings.

ALMA Explorer

•The first in a planned series of "virtual tours" of NRAO facilities, the ALMA Explorer (http://www.nrao.edu/explorer/alma/) uses dozens of short hosted or narrated video clips, aligned atop high-resolution satellite imagery of the ALMA site, to introduce visitors to the facilities of ALMA, and its geographical and cultural contexts, all in a relaxed style akin to that of park way-finding signage or ranger tours.

SETI Workshop and Webcast

An educational, multidisciplinary workshop called "From Project Ozma to the Starship Enterprise, a Conversation about the Next 50 Years of SETI" (http://www.gb.nrao.edu/ozma50/) was held in Green Bank in September, in commemoration of the 50th anniversary of Project Ozma, the first-ever deliberate search for extraterrestrial signals of intelligent origin, which Frank Drake conducted in Green Bank using the 85-foot telescope. Fifty-three invited participants, including scientists, scholars, and communicators attended, including Frank Drake, SETI Pioneer; Dava Sobel, author of *Longitude* and *Galileo's Daughter;* Jon Lomberg, artist for the *Cosmos* Television Series with Carl Sagan; and Brother Guy Consolmagno, Meteorite Curator for the Vatican.

NRAO EPO staff broke new ground during the conference by increasing public participation in novel ways. Using a portable broadcast studio and the internet, NRAO EPO staff delivered a high quality, real-time, multicamera webcast of the conference via the free Ustream distribution service (http://www.ustream.tv/), which allows much higher numbers of simultaneous viewers than possible via an NRAO server. Through simple advertising on the NRAO Facebook page and Twitter feed we drew between 150 and 210 simultaneous viewers, who conducted their own parallel conversation (including NRAO staff interaction) using the Ustream chat feature, Twitter and Facebook. A blog was also developed to allow workshop participants to comment on potential topics of discussion. Now released to the public, the blog has received 1700 hits. See http://ozmablog.gb.nrao.edu/

A month long public celebration of the 50th anniversary of Project Ozma involved regional schools, county parks and businesses. Highlights included a public talk given by Dr. Frank Drake on September 11 which was attended by a capacity crowd of 150 people. In addition, the GB Science Center distributed Drake Equation Passports to county visitors who collected stamps by locating geocaches in our local state parks, and by visiting local businesses. Those who completed their passports won small prizes and were entered into a drawing for a telescope. About 100 people logged in to the official geocaching website to report their discoveries. An arts and letters contest for elementary/middle school children drew 90 entries, which were exibited at the GB Science Center.

Filming Activity at the VLA

• Coordinated filming of NRAO employees for NM State University online feature about diversity in scientific/engineering workplace

• Coordinated filming at VLA for BBC documentary on "Do We Really Need the Moon?"

Diversity/Informal Education
• NM Highlands University is a certified Hispanic-Serving Institution.

New Staff
Sarah Scoles joined NRAO in Green Bank as our new education specialist, reporting to the Senior Education Officer. She holds a BA in Astrophysics and an MFA in creative writing and has re-located to Green Bank from her previous position at Cornell University.

$3K Grant
• Received from the NM State Division of Tourism

Community event in Socorro
• Had solar telescope and other activities at a display at the M Mountain Fly-In and Socorro Aviation Day, an event that drew more than 800 visitors to Socorro Municipal Airport

Workshop on Science Writing
• Presented "case study" workshop with students of NMT Communicating in the Sciences course, on conveying scientific results to public. Course run by English professor for Physics grad students. Used "Hole in the Universe" paper and press release as case study.

Overnight Educational Events in Green Bank conducting research with the 40-foot telescope
•National Youth Science Camp (delegates from 50 states plus Central and South American delegates)
•Gross Pointe North High School Radio Astronomy Team (MI)
•AMRAD with NSF Spectrum Management Officer Andy Clegg
•Mt Vista Governor's School (VA)
•NOVAC Almost Heaven Star Party- Tour and overnight to use the 40 Foot (DC area)
•Civil Air Patrol Cadets (VA)
•Albemarle County Math, Engineering and Science Academy (VA)
•James Madison University (VA)
•Summersville Middle School (WV)
•Hampden-Sydney College (VA)
•Roanoke Catholic School (VA)

Longer Events in Green Bank
•Society of Amateur Radio Astronomers Annual Conference
•Green Bank Star Quest Annual Multi-day Star Party with keynote speaker Carolyn Shoemaker.
•Pulsar Search Collaboratory Teacher and Students Leader Institutes. 11 teachers from KY, MD, VA, OH, PA, WV, MN, WI
•Undergraduate Students (minority students through the LSAMP program) with the Center for Chemistry of the Universe
•WV Governor's School for Math and Science (60 rising high school freshmen from WV)

VLA Explorer
•This will be the second in a series of web-based "virtual tours" of NRAO facilities. The program itself will be produced during FY2011, but filming was done in FY2010 Q4 in order to capture the VLA in its most photogenic D-configuration. Hosted by VLA scientist Rick Perley, the VLA Explorer will take

visitors into places that are strictly off-limits to the public (and to most of the staff!), including the WIDAR Correlator room and a VLA dish surface.

NAASC Proposal Review

•Presented case for EPO component of NAASC proposal

Astronomical Society of the Pacific (ASP) Conference

The ASP has become the meeting place for astronomy EPO professionals. This year's meeting was very useful as numerous case studies were presented on the effective use of social networking tools in EPO.

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  - Education and Public Outreach
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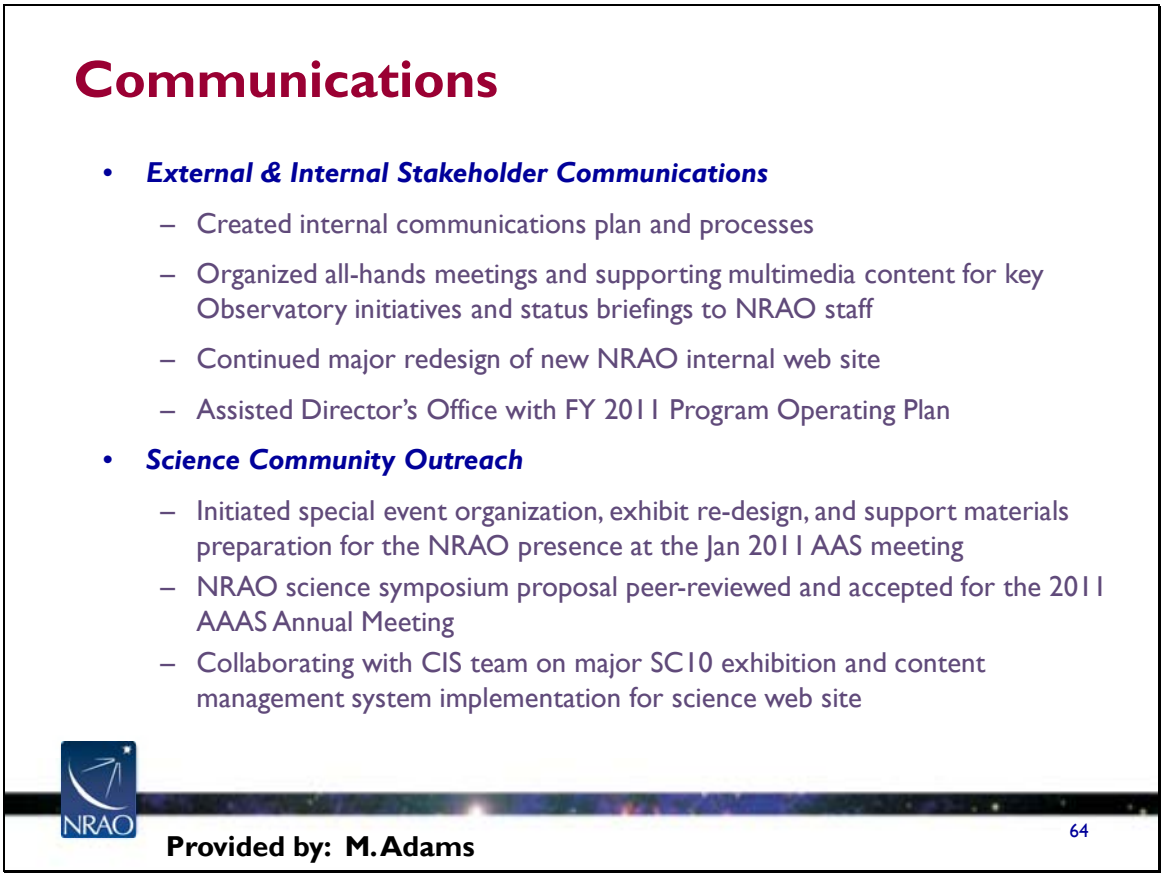
  - Spectrum Management
  - Science and Academic Affairs
  - Computer & Information Systems
  - Management & Administration Infrastructure



Internal Communications: A comprehensive internal communications plan was created and briefed to the AD team 30 Sep. COM organized the all-hands meetings and supporting multimedia content for the 29 July budget status meetings around the Observatory; and the NRAO functional alignment all-hands meetings that took across the NRAO on 5 October.

Intranet redesign: Work continued on a new NRAO Intranet site design that will transform the site into an effective internal communication tool. This work has been delayed somewhat by the resignation of Web Designer Taylor Johnson on 29 July. While we search for an individual to replace Johnson in this important full-time position, Johnson continues to support our internal and science community web design projects via a part-time consulting agreement. The internal web site design concept and structure was briefed to the AD team 30 Sep.

American Astronomical Society (AAS) meeting: In addition to the NRAO exhibition, the special events being supported by COM for the major winter 2011 AAS meeting (3000 attendees expected) include an NRAO Town Hall (Tuesday, 11 January, 6:30-8:30 pm), an ALMA Special Session (Wednesday, 12 January, 2-3:30 pm) titled *"Observing with ALMA," an* ALMA software tutorial splinter meeting (Wednesday evening, 12 January, time TBD), and an EVLA Special Session (Wednesday, 12 January, 10-11:30 am) titled *"Early Science with the EVLA."* Support materials being prepared for this AAS meeting include the 2011 NRAO Calendar, the 2011 Research Facilities brochure, and pre-loaded, branded 2 GB flash drives that will be distributed to NRAO Town Hall attendees.

American Association for the Advancement of Science (AAAS) symposium: A 90-minute VLBA-themed science symposium proposal titled "*The Universe Revealed by High Resolution, High Precision Astronomy"* was submitted in April 2010 for the 2011 AAAS Annual Meeting in Washington, D.C. This proposal has now been peer-reviewed, accepted, and scheduled for the 2011 AAAS Annual Meeting on Saturday, 19 February 2011 from 1:00-2:30 pm EST in the Walter E. Washington Convention Center, hall 146C. Our symposium's three speakers will be Mark Reid (Harvard Smithsonian CfA), Geoffrey Bower (UC-Berkeley), and James Braatz (NRAO). Mark Adams will organize and chair the session. NRAO Press Officer Dave Finley will coordinate media coverage with the AAAS Media Office.

SC10 exhibition: COM is collaborating with the CIS team to organize and lead the NRAO exhibition at the International Conference for High Performance Computing, Networking, and Storage & Analysis (SC10), which will be held at the New Orleans Convention Center, 15-18 November 2010. Approximately 11,000 scientists, engineers, software developers, CIOs, and IT administrators from universities, industry, and government agencies will attend.

Science web site: Collaborating with CIS on Plone content management system implementation. Q4 focus was establishing processes for bulk import of current science web site into Plone.

NRAO Annual Report: The initial design and text has been completed and reviewed with the Director's Office. The target audience includes funding agencies (NSF-AST et al), AUI, the AUI Board, Observatory Libraries and Directors around the world. A copy will also be provided to every NRAO/AUI employee. The report has been delayed by competing priorities, but is expected to go to the printer in November and be published in December. The Report covers FY 2010.

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Spectrum Management

- ***Green Bank RFI Group and National Radio Quiet Zone administration***
  - QZ handled 300 requests for use of 716 frequencies at 908 sites
  - AT&T agreed to limit femtocells (cell phone repeaters) in Pocahontas County
  - Andy Clegg (NSF) and an NRAO summer student mined data headers of the GBT archive to survey band frequency use
- ***Activities in New Mexico and the VLBA sites***
  - New FCC rules for TV band whitespace devices now exclude a geographic rectangle containing all three arms of the VLA

Provided by: H. Liszt

Green Bank

QZ administration database is being upgraded by NRAO IT personnel

AT&T cell phone service is available at Snowshoe and south of the GBT

Andy found that more than half of GBT proposals observe in a protected radio astronomy band

New Mexico

Whitespace devices = unlicensed fixed or personal/portable devices that use locally-empty TV channels for such things as wireless broadband internet access. The first version of these rules excluded only a 2.4 km radius circle about the center of the wye

Spectrum Management

- ***General Spectrum Management***
  - Continental United States
    - Negotiated coordination of Hughes satellite broadband internet installations within the Quiet Zone
    - Attended CORF meeting in Washington, DC
  - International
    - Attended ITU-R meetings in Geneva finalizing draft text for WRC12 on matters of interest to radio astronomy
    - Drafted IUCAF positions on WRC12 agenda items
    - Drafted revision of ITU-R Recommendation RA. 1417, protection of the radio quiet region around the L2 Sun-Earth Lagrange point

Provided by: H. Liszt

- Continental US
  - Hughes belatedly responded, favorably, to NRAO's letter of 2009 October noting FCC requirement to coordinate with NRAO regarding
  - installation of home earth stations within the National Radio Quiet Zone. Hughes and other installers have never instituted company-wide rules regarding compliance.
- International
  - 2010 meetings in Geneva finalized draft WRC input text regarding footnote protection of frequencies above 275 GHz
  - The IUCAF vice-chair authored a White Paper regarding preferred WRC actions for items of interest to radio astronomy
  - ITU-R RA. 1417 notes the importance of preserving the radio quiet environment of the L2 Sun-Earth Lagrange point

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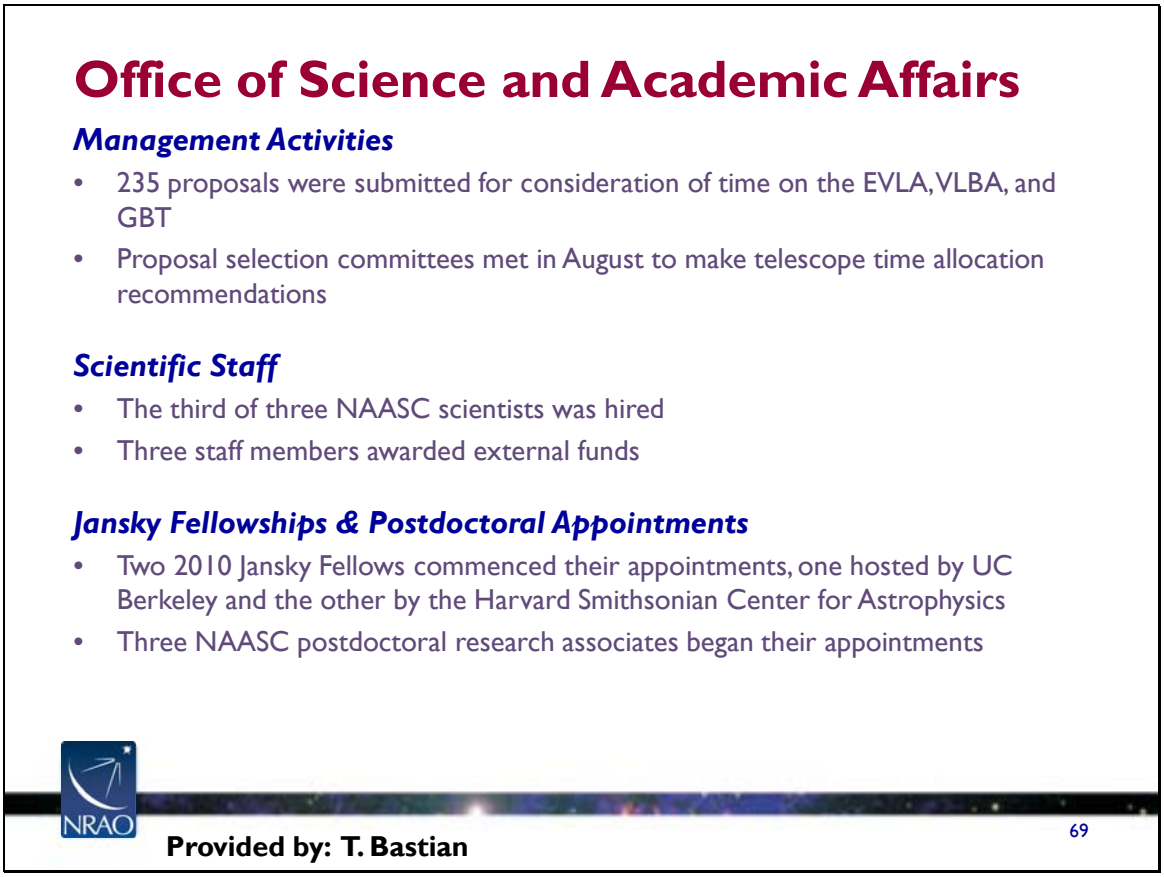

Management activities During the Jun 2010 call for proposals last quarter, we received a total of 235 proposals. The **GBT and the VLA/VLBA Proposal Selection Committees (PSC)** met in the second week of August to review the referee rankings and technical reports for all proposals with the goal of providing a recommended science program to the NRAO Director's Office. A list of the approved EVLA, GBT and VLBA/High Sensitivity Array (HSA) observing programs for Trimester 2010-C is now online (see *http://science.nrao.edu/observing/programs2010c.shtml*) .

Meetings that were funded either partially or in full this quarter by the OSAA: *From Project Ozma to the Starship Enterprise: A Conversation About the Next 50 Years of SETI,* a workshop held in Green Bank from Sep 13-15 (see http://www.gb.nrao.edu/ozma50.shtml)

NAASC scientist hires were *Adam Leroy* as Assistant Astronomer, Tenure Track; *Scott Schnee* hired at Assistant Scientist/A, and now, *Stuarrt Corder*; **NAASC postdocs** are *Amy Kimball*, U. Washington; *Robin Pulliam*, U. Arizona; *Nuria Marcelino*, Lab for Molecular Astrophysics, Madrid.

External funds: $10k from NSF to Karen O'Neil for the Project Ozma workshop; $176.8k to Scot Ransom from the PIRE grant; $43k to Rich Bradley from Cornell

NRAO received the following funds during this quarter for **grants awarded** to these members of the NRAO scientific staff:

-$38,000, from NASA, Recipient *Dale Frail,* for "NRA/ Research Opportunities in Space and Earth Sciences" from Apr 2010 to Apr 2011.
-$135,215, from NSF, Recipient *Tim Bastian*, for "Imaging Spectroscopy of Coherent Radio Bursts on the Sun: a New Probe of Magnetic Energy Release" from Jun 2010 to May 2013.
-$507,258, from NSF, Recipient *R. Craig Walker,* for "MRI-R2 VLBA Sensitivity" from Apr 2010 to Mar 2011.

Office of Science and Academic Affairs

Student and Visiting Scientist Programs

- NRAO Summer Student Program
  - The thirty 2010 summer student program participants completed their 10-12 week appointments at their assigned NRAO sites
  - Nineteen of the 2010 summer students will present the results of their summer research at the 217th meeting of the American Astronomical Society in Seattle, Washington 9-13 January 2011
- Pre-Docs
  - One University of Virginia graduate student predoc continued work under the supervision of an NRAO staff member in Charlottesville
  - New Mexico Tech predoc continued appointment working in Socorro
- Other Graduate Students
  - Five additional University of Virginia graduate students, three in astronomy, to in electrical engineering, continued work under the supervision of NRAO staff members in Charlottesville

Provided by: T. Bastian

Summer Student Program: For more information on the program go to http://science.nrao.edu/opportunities/summerstudents.shtml.

Pre-Docs: *Cheng-Yu Kuo* (Univ of Virginia Astr) continued working with Dr. Jim Braatz (NRAO/CV) on reducing and analyzing VLBI observations of water maser emission from galactic nuclei as part of the Megamaser Cosmology Project; and *Josh Marvil* (NMT) continued his appointment as a PreDoc this quarter working with Dr. Frazer Owen (NRAO/SO)

Other Graduate Students: Bin Chen (Univ Virginia Astr) continue to work under the supervision of Dr. Tim Bastian (NRAO/CV), funded through an NSF/AGS grant; Paul Ries (Univ Virginia Astr) continued to work under the supervision Dr. Todd Hunter (NRAO/CV), funded through the NRAO Student Observing Support program; Nicole Gugliucci (Univ Virginia Astr) continues to work under the supervision of Dr. Rich Bradley (NRAO/CDL), funded through the PAPER project; Rohit Gawande and Chatili Parashare (Univ Virginia EE) continue to work under the supervision of Dr. Rich Bradley

Office of Science and Academic Affairs

Student and Visiting Scientist Programs cont.

- Graduate and Undergraduate Interns
  - Four graduate students, two from the University of Virginia, one from Universidad Nacional Autonoma de Mexico, and the fourth from NUI Galway (Ireland) began or continued work as graduate interns with NRAO mentors
  - Nine undergraduates (all New Mexico Tech) continued undergraduate internships working in the Electronics Division in Socorro
- Visiting Astronomers
  - Two astronomers, supported jointly through SAA and the NAASC, completed their visit

Provided by: T. Bastian

Graduate Interns: *Charles Romero (UVA)* is working with Brian Mason on quantifying the observational signatures uniquely accessible through high resolution SZE data (e.g., shocks and cold fronts, helium sedimentation), and applying them to MUSTANG data and if available data from GISMO on the IRAM 30m at 150 GHz; *Timothy Pennucci (UVA)* is working with Scott Ransom on the NANOGRav project; *Sergio Dzib (UNAM)* is working with Amy Mioduszewski on research projects related to the distance of young stars which will be part of his Ph.D. thesis, and *Leon Harding (NUI Galway*) is working with Greg Hallinan on broadband periodic dynamic spectra of ultracool dwarf pulsars.

Undergraduate Interns: *Dana Sills, Cameron Welch, Aaron Cunningham, Deepak Rai, Sara Waters, James Durand, Jordan Leak, Scott Davidson* (funded by EVLA), *Matt Tibbetts* (funded by EVLA).

Visiting Astronomers: Jack Gallimore and Michele Thornley, both of Bucknell University

Office of Science and Academic Affairs

Support Programs

- Student Observatory Support
  - SOS Selection Committee met in September
    - ✓ Selected four of eight 10C proposals for funding
- Observatory Library
  - The Library has completed the full-text scanning of the GBT and EDIR memo series which are now available electronically. This project will continue until all NRAO Memo Series, reports, and other materials are available digitally.
  - The Library staff has moved the Exchange and circulating book collections and now shifting the journals, which will be arranged in strict alphabetical order when complete.
  - The Library scanned and made available electronically (via the Library catalogue) three NRAO workshop titles.

Provided by: T. Bastian

SOS Awards: The SOS committee recommended funding a total of **$106,500 to 4 of the 8 proposals submitted (only 7 of which were allocated observing time and considered for SOS funding)** this period. They are as follows: GBT10C-063, supervisor, Jim Jackson, student Susanna Finn, Boston University, for **$20,000**; GBT10C-064, supervisor Mark Morris, student Elisabeth Mills, University of California, Los Angeles, for **$35,000**; VLA10C-173, supervisor Lisa Young, student Kristina Nyland, New Mexico Tech, **$19,500**; VLA10C-225, supervisor Min Yun, student Hansung Gim, University of Massachusetts, **$32,000**

Information on the SOS Program can be found at *http://science.nrao.edu/opportunities/sos.shtml*.

Observatory Library: The three NRAO workshop titles available electronically are as follows**:**
1. *Low frequency variability of extragalactic radio sources* : proceedings of a workshop held at the National Radio Astronomy Observatory, Green Bank, West Virginia, April 21-22, 1982
2. *Serendipitous discoveries in radio astronomy* : proceedings of a workshop held at the National Radio Astronomy Observatory, Green Bank, West Virginia on May 4, 5, 6 1983
3. *The search for extraterrestrial intelligence* : proceedings of an NRAO workshop held at the National Radio Astronomy Observatory, Green Bank, West Virginia, May 20, 21, 22, 1985 / edited by K.I. Keller

Office of Science and Academic Affairs

Support Programs cont.

- Historical Archives
  - Processing continued on various papers from the NRAO as well as individual members of the scientific community
  - The Archives received an installment of materials – audio cassette tapes and related paperwork – to be digitized and catalogued.
  - During this quarter the Archivist visited the National Archives and Records Administration's National Archives Center for Advanced Systems and Technologies (NCAST) Research Laboratories.
  - The Archivist created a Web page for the IAU Historic Radio Astronomy Working Group, see http://rahist.nrao.edu/.

Provided by: T. Bastian

Archives: Papers of *Ronald N. Bracewell*, the Papers of *David S. Heeschen*, and materials from the Director's Office. *Dr. Woodruff T. Sullivan III's* audio tapes are primarily interviews made over the period 1971-1988 with approximately 260 radio astronomers, including many pioneers in the field. About 20% of the tapes are of meeting talks related to radio astronomy history, and they will also be digitized. With the help of Josh Malone, processes and protocols for digitizing these fragile tapes have been developed, and the first several tapes were digitized before Dr. Sullivan's two-day visit to review the digitization done, discuss details of processing, and plan for future shipments of paper materials in his collection. In consultation with American Institute of Physics, Center for the History of Physics, we have developed procedures for obtaining the necessary oral interview donor agreements from interviewees or their heirs.

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

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Computer & Information Services

- ***Common Computing Environments (CCE)***
  - Successfully completed second ALMA User Portal and Helpdesk integration test
  - Plone Content Management System now running Version 4 and being populated
  - Improved security on passwords and digital signatures now in place
- ***Networking and Telecommunications***
  - GSA complete for 4 of 5 services; WAN contract pending one VLBA site install
  - Circuit negotiations in place for initial 10 Gigabit link into Green Bank
  - Contract finalized with AURA for network from Chile to US for ALMA data
  - Green Bank Phone and Voice Mail system replaced under ARRA funds
- ***Digital Infrastructure***
  - 120 TeraBytes of NGAS storage running in NAASC for ALMA Early Science
  - Lustre HPC parallel file system improving EVLA data access for CASA
  - Live EVLA data ingestion and replication verified under NGAS
- ***Security***
  - CIS/MIS and HIPPA Risk assessment audit completed in cooperation with AUI
  - No production impacting security incidents occurred this quarter

NRAO

Provided by: D. Halstead

75

CCE: ALMA/NRAO High Availability servers now in place running the Helpdesk and Plone web-based Content Management System and User Portal including user authentication to JAO user database

Successfully completed Q4 integration test against requirements for ALMA observer supporting helpdesk.

NRAO Plone installed and configured to replicate the style and structure of www.nrao.edu, which will allow for workflow control over online document and content publication.

Improved user password security and digital signature certificate authority now running within NRAO

Network: Transitioned Long distance, International, Calling cards and voice/web Conferencing to the new Networx contract. Only the Brewster WA VLBA site remains from WAN upgraded in October.

Ongoing commitment to upgrade ALL major sites to **1Gigabit/Second** to facilitate data access: Complete for C'ville and Socorro; WV State awarded $8M million in economic stimulus funds to deliver 10Gbit/sec from Green Bank to WVU and on to the North American Research Networks: due Q4 FY 2011

A contract has been finalized with AURA for **1Gigabit/Second link from ALMA SCO to NA-ASC** with connectivity in Q1 FY11

ARRA funds have been used to successfully replace the PBX and Voicemail system used throughout the Green Bank WV site.

Digital Infrastructure: **ALMA archive servers, User Portal and Oracle Database** now running in Charlottesville with initial test data now on-line.

The Next Generation **Science Data Archive** System servers now storing and replicating production EVLA data in Socorro leveraging high speed Lustre file system for staging data for CASA

Access to 200 TeraBytes of Archive storage and 100,000 hours of computer time being leveraged from NSF TeraGrid to support the re-use of the 350MHz GBT pulsar survey data.

Security: **IT Risk Assessment** review was successfully completed with Cherry, Bekaert & Holland, L.L.P. and a HIPAA review with Mercer. Recommendations to be executed throughout FY11

No **production** downtime from security vulnerabilities occurred this quarter.

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Observatory Management Services

- ***Management Information Services (MIS)***
  - Design, Software Coding and Testing for AUI recommended Cost Pools in process for FY 10 Q4 and anticipated complete date FY 11 Q1
  - Preparation and development of NRAO year end changes and enhancements (complete)
  - Continue the stabilization and enhanced data mining for the NRAO Electronic TimeKeeping (ETK) systems
  - Continued establishment of the MIS business systems as the central repository for employee information with exports to the NRAO phone directory and business services will be included in the AUI recommended Cost Pools project
  - Planning for J.D.Edwards upgrade to begin in FY2011
  - Planning for NRAO reporting enhancements needed for the NRAO Program Office initiatives

Provided by: T. Miller/G. Clark

Observatory Management Services

- ***Fiscal Division***
  - Implementation for employees in Socorro and the VLBA sites of ACH payments for employee travel reimbursements [Q1]
  - Implementation was completed in Q4 of FY 10.
  - Re-design of the "Fringe Pool" to increase the efficiency of the allocation of fringe benefits [Q1]

  Fringe pool redesign has been rescheduled to Q 3 of FY 11 due to increased workload.
  - Research and initiate implementation of ACH payments to vendors for all categories of payments [Q4]

  Research was initiated in FY 10, Q4 and a process drafted to initiate vendor payments via ACH on a test group of vendors at one site. Upon successful completion of implementation at the selected site the process will be expanded to the remaining aites.

Provided by: T. Miller/G. Clark

Observatory Management Services

- ***Contracts and Procurement***
  - The Observatory-wide contractor procurement system review (CPSR) report finalized by CBH, internal auditors
    - Actions continue to be taken to address recommendations,
  - Support NSF IG/DCAA audit support (FY10 Q4-FY11,Q2)
  - ARRA
    - BDO Seidman, the external auditor, and NSF IG/Booz Allen to conduct an audit of ARRA awards (FY11, Q1-Q2)
    - Coordinating with NSF for re-alignment of ARRA fundsFY10,Q4-FY11, Q1
  - Conducted a procurement review in Chile for FY10 Q1 activity
    - FY10 Q2-Q4 review scheduled FY, Q1
  - ALMA efforts
    - NSF approvals for purchases over $250k (FY10, Q4-ongoing)
    - Import/Export activity increased 74% over FY09 to 650 transactions
    - Supported ALMA with replacement contractor for AOS Utilities Installation contract
  - Non-AST NSF efforts
    - Assisted with a large number of Non-AST NSF funding opportunities in Q4
  - Manuals
    - New P-Card Manual draft and final by FY11, Q2
    - Procurement Manual complete update by FY11, Q1

NRAO

Provided by: P. Donahue/G. Clark

In the Contracts and Procurement area in Q4, continue to implement and evaluation additional recommendations made in the Contractor Procurement System Review Report. New administrative requirements, and audits, are increasing Buyer's workload resulting in overtime and increasing the GB Buyer from .5 to .75FTE. The Buyers completed the year by issuing 6.077 purchase orders for approximately $29,850,000.

Significant time and energy used to support the continuous, and increasing number, of audits. ARRA focus continues. All impacting existing resources and ability to process PR's and conduct the procurement process in a thorough and complete manner.

A procurement review was conducted in Chile for Q1 FY10 activity. Q2-Q4 scheduled for December 2010. Due to AUI's directive that's changed the travel budgeting/charging methodology, the NA ALMA Business Manager had performed the Q1 review in lieu of C&P, thereby reducing risks that could result if a review wasn't conducted.

ARRA expenditures continue to be a major focus, and soon ARRA audits. Working with NSF in Q4 to re-align remaining ARRA funds to new projects.

The CAP manuals have been escalated to a higher priority level.

There was an initiative for FY2010 to establish an expanded and user-friendly web presence in which internal and external customers will be able to obtain standard procurement forms, terms and conditions, representations and certifications, and proposal materials. The website is at risk and will not be updated as planned. Due the number of audits and re-prioritizations, the website update is being moved to FY2011.

Observatory Management Services

- **Environmental Safety and Security**
  - ***Charlottesville***
    - ***Edgemont***
      - Routine fire extinguisher inspections completed
      - Routine fire main/alarm maintenance in Stone hall completed successfully
      - Budget reduction was accomplished as requested
      - Attended the Executive Safety Meeting at the OSF
      - Supported Front End Service Vehicle Design Review In Taiwan
    - ***NTC***
      - OSHA Mandated Training complete
      - Fire Extinguisher program transferred from paid Contractor to ES&S
      - Mike Stogoski is now NTC Volunteer Safety Coordinator

Provided by: R. Daniels/G. Clark

Edgemont Road Facility: Quarterly Building Maintenance Inspections completed. Fire Extinguisher Inspections completed. Fire main and alarm maintenance completed in Stone Hall. Alarm tests successful. All routine. **Executive Safety meeting**-Travelled to OSF on Saturday after hearing of the fatality. The review was refocused into a meeting to support the investigation & rules changes.

NTC Now has an internally operated Fire Extinguisher management program. Also a volunteer Safety Coordinator to ensure that we take full advantage of internal resources before we use outside resources ($$$).

Observatory Management Services

- **Environmental Safety and Security**
  - ***New Mexico-DSOC***
    - Outreach with NMIMT Emergency Coordinator, PD Chief and Socorro County Sheriff Department
    - Blue laser research for acquisition by an NRAO employee
    - Safety walk-through at DSOC with employees
    - Attended Safety Committee meetings: 7/13/10, 8/12/10, 9/9/10
    - Environmental issues/Green Initiatives
    - Safety Training

New Mexico Facilities-Outreach activities-NMIMT Emergency Coordinator: Surveyed campus flood hazards and their mitigation as they affect NRAO employees and discussed various security issues including earthquake and "active shooter" awareness; NMIMT PD Chief: Discussed various security concerns and advised him of DSOC employee schedules to enable his department to provide additional security; Socorro County Sheriff: Discussed VLA site security issues and discussed DSOC & ROB security issues. **Blue Laser Research**-advised against it because of unreasonably high probability of inadvertent injury in the proposed application. **DSOC Safety walk through**-to educate in various safety issues: extension cord use, egress & ingress clearances. **Environmental/Green Initiatives:** transported about 120# of used batteries to VLA holding facility and transported about 15 gallons of used isopropyl alcohol to the VLA used oil facility. **Safety Training-**developed and implemented a process to distribute the Weekly Safety Topics to all of NRAO facilities (Safety Blog); developed short PowerPoint safety overview for visiting scientists (JPL), addressed five pertinent safety issues: elevation hazards associated with going from sea level to 7000', low ambient humidity, poisonous reptiles, storm event safety, and personal security and sent to the Jet Propulsion Laboratory who will use it to supplement their own training; new DSOC-based employee safety orientation for five employees.

Observatory Management Services

- **Environmental Safety and Security**
  - ***New Mexico VLA Site:***
    - Monthly meetings and training sessions conducted
    - Ongoing Green actives
    - Closed out of final item for NMEPA PSTB NOV #3882
    - Outreach activity w/local fire departments and area clubs
    - Monthly and Quarterly Inspections and testing.
    - EMS refresher session completed

New Mexico VLA Site: Meetings and Training Sessions-training sessions offered in Lockout/Tagout and Cranes, Hoist & Slings and Slip, Trip and Fall awareness, as well as Understanding Safety at work; new employee safety orientations. The SO attended weekly coordination meetings, monthly safety committee meetings and ES&S coordination meeting. The EMS continued having monthly meeting time permitting.
Ongoing Green actives: continue with 2,960 Lbs of Lead-acid Batteries with Wise Recycling, 2,161 gallons of dyed diesel and oil with Mesa Environmental, 350 gallons of antifreeze, 300 gallons of heavy grease, and 200 gallons of machining oil. **Closed out final item for NMEPA PSTB NOV #3882-** The last item of the NOV 3882 was closed out with the replacement of the 25K gallon diesel tank. The tank was replaced with a 15k gallon doubled walled tank. New pump and leak detector system was also installed. **Outreach activities-**assisted Datil Fire Department with required NFPA hoses testing. SO assisted Magdalena Fire and EMS with ambulance and fire truck inspection and responded under mutual aid agreement. SO provided and participated with Magdalena ISD rock club, rocket building projects, SO provided tour for NRAO visitors under NRAO EPO. **Monthly and Quarterly Inspection and testing-**conducted monthly fire extinguisher inspection on all building fire extinguishers; conducted quarterly extinguisher inspection on all antenna fire extinguishers. EPA monthly generator logs completed and up-to-date. Biannual generator EPA air quality report completed and submitted. Monthly fuel tank inspection conducted and filed. NFPA 25 inspection and testing completed. **EMS refresher:** SO attended EMS refresher for license renewal.

Observatory Management Services

- **Environmental Safety and Security**
  - ***Green Bank***
    - Recycled 500 gallons of used oil
    - Sewer treatment system continues in compliance since January 2007
    - Performed annual OSHA inspection of Green Bank site
    - Safety Training completed
    - Accidents/Injuries frequency & severity below Observatory's operating units average
  - ***VLBA Sites***
    - Ensured all VLBA sites had updated (or new) First Aid kits/supplies

Provided by: R. Daniels/G. Clark

Green Bank Facilities: Recycling efforts continue with 500 gallon of used oil recycled this quarter. **Site sewer water treatment system** continues within limits performance for the third successive year. Annual **site OSHA inspection** was conducted in July with no major issues to report. **Training** was conducted in the area of Respiratory Protection refresher and new employee safety orientations.

VLBA Facilities: All sites updated with first aid kits and/or supplies.

Observatory Management Services

Name of Grant	Funding Institution	Grant Value	PI
SETI-Ozma Workshop	NSF	$10,000.00	Karen O'Neil
USNO	USNO	$373,590.00	John Lagoyda
PIRE	WVU	$176,776.00	Scott Ransom
LNA QSC Broadband	Cornell	$43,120.00	Rich Bradley

Provided by: T. Miller/G. Clark

MRI-R2 VLBA Sensitivity period of performance: April 1, 2010 to March 8, 2011
Research Opportunities in Space and Earth Science: April 15, 2010 to April 14, 2011

Observatory Management Services

- ***Human Resources***
  - ***Recruitment/applications tracking***
    - Developing a process of evaluating the effectiveness of NRAO recruitment efforts - completed
      - Monthly requisition report included in FLASH report
      - Track recruitment sources and make recommendations
  - ***Compensation***
    - Thorough review of NRAO's compensation process including the grade structures and market surveys [Q1]
  - ***Diversity Outreach***
    - Development of an action plan that builds a diversity support network from site level up to the Charlottesville headquarters - completed
      - Distributed cultural awareness posters to all sites
      - Developed Diversity Advocate model (role definition)
      - Incorporated broader impact/diversity goals into PEP process

Provided by: F. Giles/J. Firmani

Recognition in Diversity Careers magazine resulted in # diversity applicants seeking employment at NRAO.

Observatory Management Services

- ***Human Resources***
  - ***Diversity Outreach***
    - Development of an action plan that builds a diversity support network from site level up to the Charlottesville headquarters - completed
      - Launched new diversity webpage on NRAO website
      - Recognized as Best Diversity company by readers of Diversity Careers
      - Design, develop and conduct broader impact/diversity training across Observatory
      - Commencement of Diversity Advocate Meetings
      - Establishment of partnership with African American Teaching Fellows to collaborate on STEM initiatives
      - Establishment of partnership with Boys & Girls Club of Virginia to create STEM opportunities for underrepresented youth in the community
    - Assist Howard University in further developing it astronomy program - completed
      - Working with Richard Prestage in GB to create internship opportunities

Provided by: F. Giles/J. Firmani

Recognition in Diversity Careers magazine resulted in # diversity applicants seeking employment at NRAO.

Observatory Management Services

- Human Resources - **New Hires**
  - Diversity Employment Results Q4
    - » **SOC**
      - Track Operator – (Minority)
      - Asst Scientist /CS – (Female/Minority)
    - » **GB**
      - Housekeeper/Food Handler – (1) (Female)
      - Public Education Spec (Female)
    - » **CV**
      - Post Doc – (Female)
      - Admin Asst /NAASC – (Female)
      - Jansky Fellow – (Female)
      - Research Assoc – (Minority)

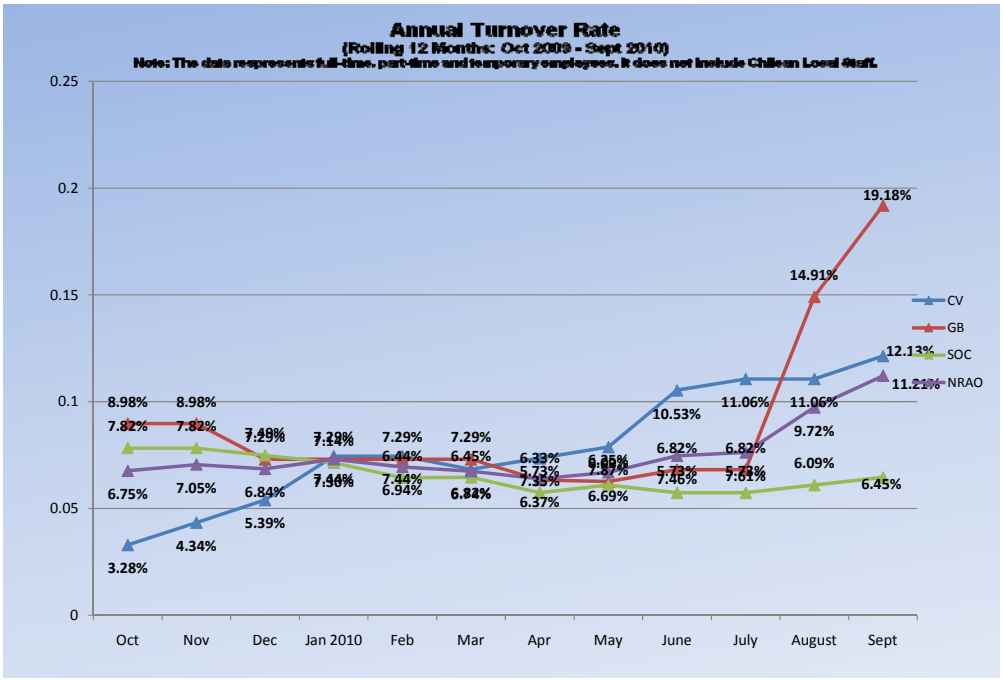
Observatory Management Services

- Human Resources – Promotions
  - Diversity Employment Results Q4
    - » **SOC**
      - Scientific Assoc III – (Female)
    - » **GB**
      - None
    - » **CV**
      - None

Observatory Management Services

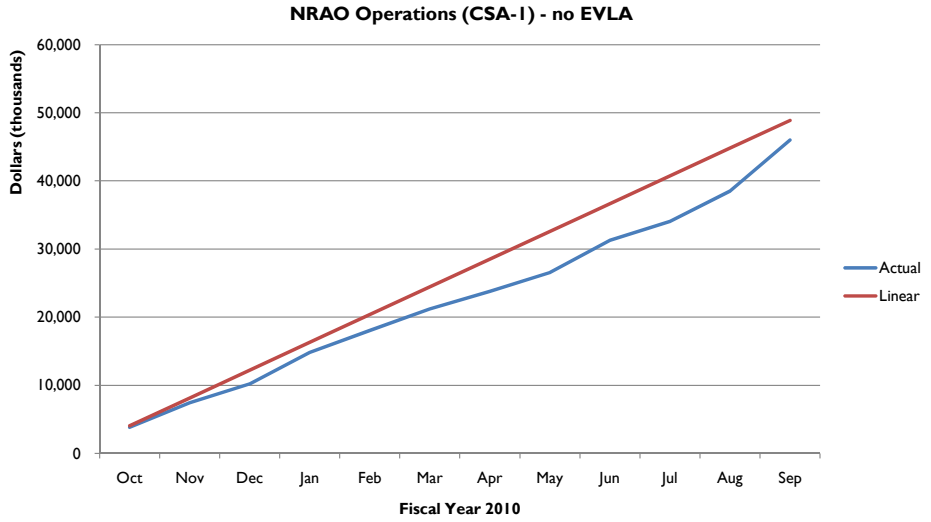
- ***Human Resources***
  - ***Workforce Management Planning***
    - Observatory Staffing Plan (OSP)
      - Completed Critical Skills assessment
      - Completed compilation of all NRAO employees critical skills information
      - Put database under HR configuration control
      - Completed staffing roll-on, roll-off for NRAO-wide (including ALMA and EVLA)

Provided by: F. Giles/J. Firmani



Provided by: F. Giles/J. Firmani

Observatory Management Services Financial Performance



Provided by: T. Miller/G. Clark

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NRAO Operations (less EVLA) FY 2010 new funding allocation is $43,144k. Total available funding including prior year commitments and carryover totals $48,879k. Total spending for FY 2010 is $45,982k with the remaining $2,897k to cover anticipated FY 2011 and FY 2012 funding shortfalls.