Quarterly Status Update (QSU) Q1 FY 2010
October-December, 2009

Presentation to NSF on February 17, 2010

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

Primer

- The structure of this presentation has been set up in a consistent pattern for easier reading
- The milestones that are recorded here come directly from the Program Operating Plan
- Changes (change in work project or scope, slips in schedule, etc.) that are affecting the stated POP milestones are reflected through risk mitigation processes described in the body of the presentation
- New work that is being done (outside the POP) is included
- Names, titles, citations, web addresses, etc. included the NOTES

The **PURPLE** text is what is **REQUIRED** to be updated by you.

These are items previously specified in the Program Operating Plan 2010 (POP FY2010). Include risk and mitigation against meeting required actions in both the SLIDE and the NOTES section.

CHANGES or NEW items to the POP in **GREEN** text.

New activities that were not previously described in the POP, and changes to activities in the POP, are included in the slides.

Items that are of greatest interest to NSF in **RED**.

Identify and report on the **TOP** 3-4 items.

Agenda

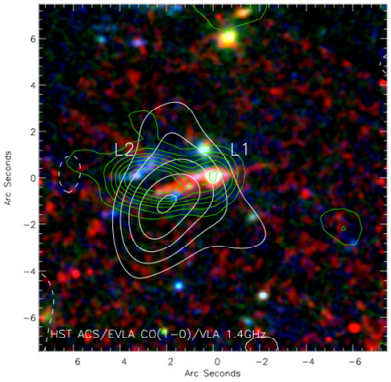
- Science Results
- Metrics/Statistics
- Observatory Science Operations
- Site Specific Activities
  - ALMA
  - VLA/EVLA
  - GBT
  - VLBA
- Observatory-wide Operations

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.

EVLA Science Results

- EVLA reveals colossal galactic nursery at z=2.8: Using new Ka band, Ivison et al. have imaged a huge molecular gas cloud associated with a massive star forming galaxy in the early Universe. The cloud is larger than 25 kpc, with enough molecular gas to create the stars in a large elliptical galaxy.

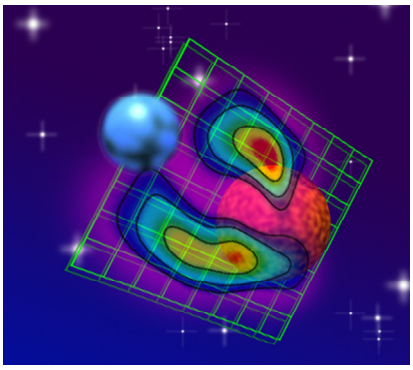
- EVLA imaging of magnetic fields in a massive star forming region: Momjian et al. have used the new Ka system to study the Zeeman effect in methanol masers in M8E. They find struture scales ~ 1000 AU, and dynamically strong fields.

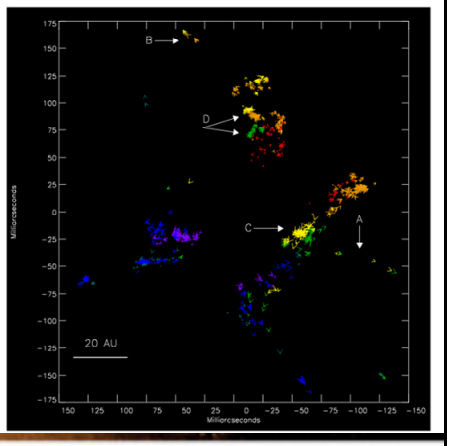


- Ivison et al. MNRAS in press – They have used the new frequency range of the EVLA (27 to 40 GHz) to detect molecular gas, the fuel for star formation in galaxies, in a very distant forming galaxy. The surprise is the huge mass of cold gas fueling early galaxy formation.
- Momjian et al. ApJ in press: They have studied Zeeman splitting of methanol masers from a massive star forming region in the Galaxy. Their measurements show a field reversal on a scale of 1000 AU in the cloud. Magnetic fields are crucial elements of the star formation process, and they find that the fields are a strong enough (30mG) to affect the cloud collapse.

VLBA Science Results

- Magnetic loop connecting the binary stars in the Algol system seen with the HSA on sub-AU scales: Peterson et al. have made the most detailed image of the magnetic field around any star besides the Sun.
- VLBA 'movie' provides the most detailed view of the dynamics of gas within 20AU of a young massive star: Mathews et al. have imaged the SiO masers in an YSO in Orion down to 0.2AU resolution. These reveal a bipolar outflow from the accretion disk, likely magnetically confined.
- The VLBA has provided the first direct distance measurement to a Galactic black hole: The measurement by Miller-Jones et al. is key to understanding the physics of these energetic systems.





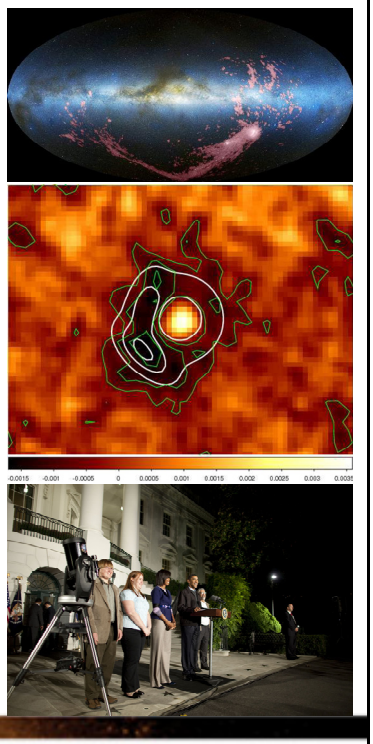
NRAO

Provided by: B. Dickman/C. Carilli

- Peterson et al. Nature, in press show that the magnetic field in a close stellar pair connects the two stars, and rotates with the stars.
- Mathews et al. ApJ 2010, 708, 80, show that the formation of a massive star (8Msun) – a long outstanding problem in astronomy, is through disk-mediated accretion.
- Miller-Jones et al. ApJ, in press, find that black hole accretion was not super-Eddington during its 1989 outburst. The fitted distance and proper motion imply that the black hole in this system likely formed in a supernova, with the peculiar velocity being consistent with a recoil kick.

GBT Science Results

- GBT generates a unique image of the Magellanic Stream: Nidever et al. imaged the neutral hydrogen in a giant stream of gas enveloping the Galaxy. The gas is seen to be continuous over tens of kpc scales, and connect our nearest two companion dwarf galaxies. The stream likely originated as outflow from these galaxies driven by active star formation.
- GBT images Sunyaev-Zel'dovich effect in z=0.5 galaxy cluster: Mason et al. used the 90GHz array on the GBT to create the highest resolution SZE map ever made to detect the hot gas from a major merger event in the cluster.
- High school student Lucas Bolyard finds a rare type of neutron star, one of only 30 known in the Universe, and gets to meet the President!



Provided by: J. Lockman/K. O'Neil/C. Carilli

- Nidever et al. AAS 2010 show that the Magellanic stream that envelopes our Galaxy is a continuous stream of gas on tens of kpc scales. Their measurements make the Stream about 1.7Gyr old, likely related to the active star formation in the Magellanic clouds, which then connect our nearest two companion dwarf galaxies.
- Mason, et al used MUSTANG64 to detect hot (>20 keV) gas in the southeast corner of RXJ1347-1145 which is the result of a recent, violent merger event and is one of only three confirmed shocks ever detected in the intra-cluster medium of galaxy clusters. This was also the highest ever resolution map (10") of the SZE in any galaxy cluster
- The student working as part of the 'pulsar collaboratory', analyzed data from the GBT and found a rare type of rotating neutron star, a 'rotating radio transient', one of only 30 known. The work is being done as a collaboration between NRAO and the WV high schools.

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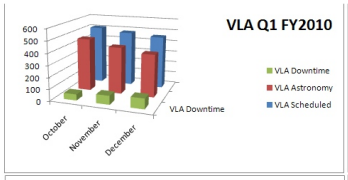
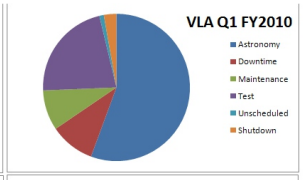
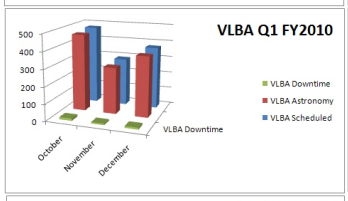
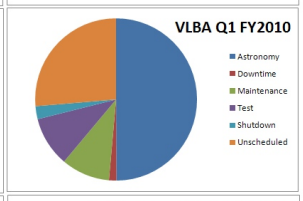
Telescope Utilization (Astronomy, Downtime, Maintenance, Test/Calibration, Unscheduled)

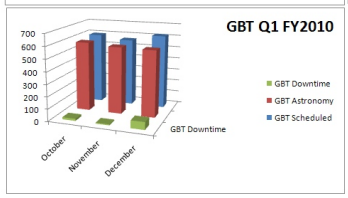
	Available Hours		744	744	720
		Q1	October	November	December
VLA	Scheduled	1446.45	509.17	479.79	457.49
	Astronomy	***1228.47***	*456.23*	*403.98*	*368.26*
	Downtime	***217.98***	*52.94*	*75.81*	*89.23*
	Maintenance	195.5	62	62	71.5
	Test	483.32	170.76	134.4	178.16
	Unscheduled	21.73	2.07	17.31	2.35
	Shutdown	61	0	26.5	34.5
	Total Hours	2208	744	720	744
		Q1	October	November	December
VLBA	Scheduled	1135.25	474.5	287.75	373
	Astronomy	***1102.8***	*461.21*	*279.41*	*362.18*
	Downtime	***32.45***	*13.29*	*8.34*	*10.82*
	Maintenance	214.5	67.5	68	79
	Test	219.955	77.505	56.26	86.19
	Shutdown	57	0	24	33
	Unscheduled	581.295	124.495	283.99	172.81
	Total Hours	2208	744	720	744
		Q1	October	November	December
GBT	Scheduled	1776.44	594.3	565.34	616.8
	Astronomy	***1687.14***	*576.79*	*557.14*	*553.21*
	Downtime	***89.3***	*17.51*	*8.2*	*63.59*
	Maintenance	205.61	94.95	60.58	50.08
	Test	153.95	54.75	58.08	41.12
	Shutdown	72	0	36	36
	Unscheduled	0	0	0	0
	Total Hours	2208	744	720	744

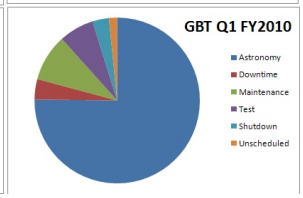












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Scheduled = planned observing time.

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.

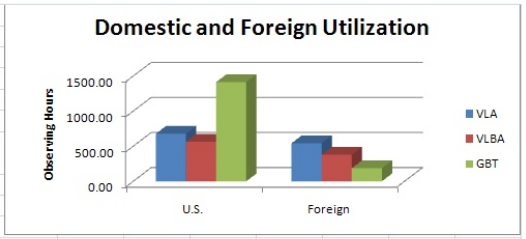
Unscheduled = time that went idle (unplanned); for example, for VLBA if no media was available or due to the 10 weather environments and the tiger team visits; for VLA if no dynamic project fit, for GBT = holiday.

Shutdown = time unable to be scheduled.

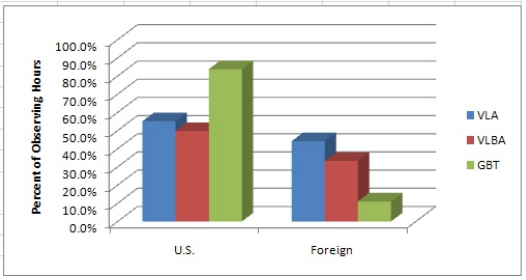
Downtime = faults that occur during a planned observation; e.g., circuit breaker fault, fraction of array unavailable, etc.

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

	U.S.	Foreign	Unspecified
VLA	677.91	542.03	8.61
VLBA	564.25	378.00	193.00
GBT	1412.94	185.79	88.38



	U.S.	Foreign	Unspecified
VLA	55.2%	44.1%	0.7%
VLBA	49.7%	33.3%	17.0%
GBT	83.7%	11.0%	5.2%



NRAO

Provided by: R. DuPlain/N. Radziwill/G. Hunt

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All metrics are compiled by principal investigator, not project team. All proposals for the VLA, VLBA, and GBT are submitted via the PST. The number of proposals submitted for the Oct 1 2009 deadline are from the PST. These proposals are used to map against the telescope usage to determine US, Foreign, etc.

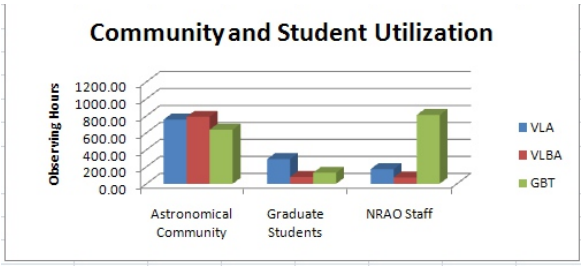
Once a proposal is accepted, it can get telescope time for many trimesters to come. Most of the VLA and GBT projects which were scheduled time during Q1FY10 have proposals which were submitted via the PST, since these telescopes have been using the PST for years. However, VLBA only started using PST in 2008. Also note that it's not uncommon for VLBA projects to get telescope time over the course of many years. For the VLBA, most of the hours scheduled in recent quarters have been to projects which have proposals that pre-date the PST. When we run these charts each quarter, we soon have to start digging manually for proposal information for VLBA projects which is a time-consuming process. The unknowns were minimized as well as possible.

Top graphs are in **observing hours**.

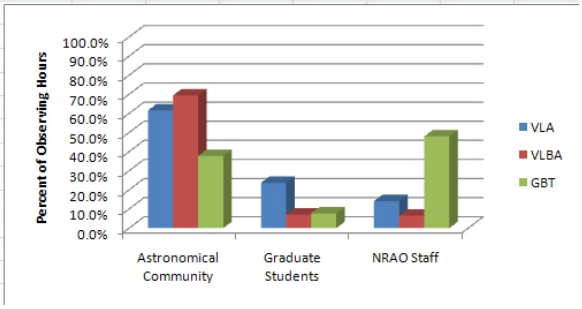
Bottom graphs are **in % of observing hours.**

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

	Astronomical Community	Graduate Students	NRAO Staff
VLA	756.03	290.70	173.21
VLBA	788.00	80.00	74.25
GBT	636.65	129.52	809.63



	Astronomical Community	Graduate Students	NRAO Staff
VLA	61.5%	23.7%	14.1%
VLBA	69.4%	7.0%	6.5%
GBT	37.7%	7.7%	48.0%



Provided by: R. DuPlain/N. Radziwill/G. Hunt

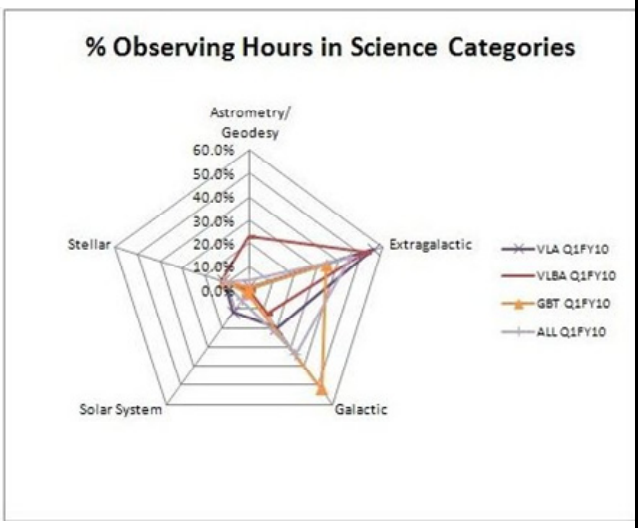
All metrics are compiled by principal investigator, not project team.

Top graphs are in **observing hours**.

Bottom graphs are **in % of observing hours.**

Telescope Usage by Science Category

	GBT	VLA	VLBA
SOLAR SYSTEM	1.5%	11.7%	0.0%
STELLAR	10.9%	11.3%	12.6%
GALACTIC	52.2%	20.2%	12.6%
EXTRAGALACTIC	34.5%	55.7%	52.1%
ASTROMETRY/GEODESY	0.9%	1.1%	22.7%



NRAO

Provided by: R. DuPlain/N. Radziwill/G. Hunt

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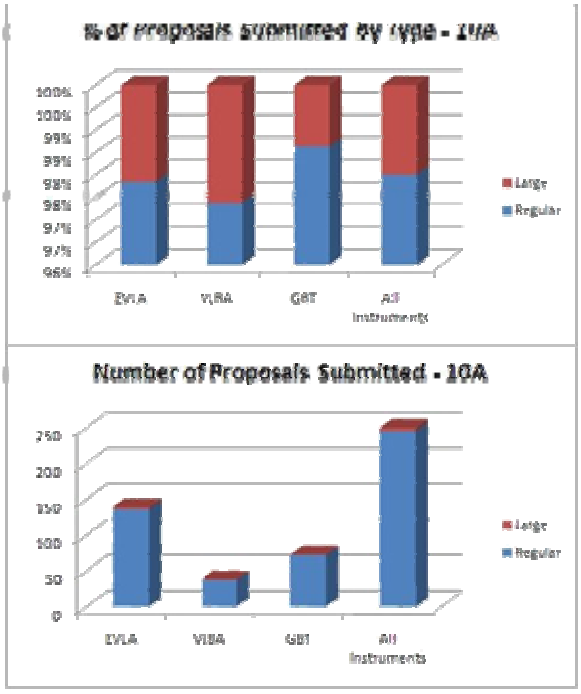
This information is obtained from the proposal coversheet which includes scientific categories. The proposals tend to include one to three scientific categories per project. The metrics are created by splitting time (minutes) evenly over the categories listed on the proposal coversheet.

Proposals Submitted during Reporting Period

	Regular	Large	Total
EVLA	136	3	139
VLBA	37	1	38
GBT	72	1	73
All Instruments	245	5	250

Number Requesting Student Support: 10
(9 Regular, 1 Large)



Provided by: R. DuPlain/N. Radziwill/G. Hunt

Top graphs are **in % of large and regular proposals** – y-axis zoomed in to see differences.

Bottom graphs are **in counts of large and regular proposals.**

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Organization: In this quarter, work continued on developing the detailed definition of site-specific, versus OSO roles; and in fully defining the interfaces to other NRAO divisions, including the telescope sites. This scoping activity will be completed in Q2 per the plan. An Implementation Plan will be delivered in April 2010 that will include the proposed OSO organization, responsibilities, personnel, and costs. This quarter, a draft OSO document was completed by the OSO working groups and prepared for the next step, for a larger review by the NRAO ADs.

User Communications & Programs: All activities for development of the science web and science user outreach can be found in this presentation under Communications. An important milestone was reached in the **new science Internet presence** debuted 31 December. Outreach also included the completion of preparations for the winter **AAS** meeting. The user training activities have not yet started but are still on plan for completion in Q4.

All User Access and Support/ Helpdesk and Portal: **Production support** for the Observer Helpdesk on track, **hired a User Portal Programmer**-CIS ; NAASC tested Helpdesk, and **has hired a developer** for Helpdesk and User Portal integration effort. On plan to launch the helpdesk as a production version for EVLA, CASA and AIPS in Q2 and to implement for beta testing for the ALMA project in Q4. Also on track to upgrade the NRAO User Portal to accommodate NA ALMA users in Q4.

OSO Specific Milestones

- ***Observation Preparation***
  - Setups for the WIDAR correlator were incorporated in the OPT (see EVLA)
- ***Proposal Process***
  - Integration of EVLA into PST-Proposal Handling Tool completed
- ***Data Processing and Analysis***
  - Data Processing Software
    - The first public version of CASA was released for EVLA (see EVLA)
    - CASA version 3.0 released (see ALMA)
    - A dynamic CASA wiki tutorial with guides and examples went live (see ALMA)
    - CASA (Common Astronomy Software Applications) package adopted SKA (see NIO)
  - Computing
    - Partnering with UVa on CASA speed-up through the High Performance Computing Activity (see CIS)

As reported in the EVLA section, Setups for the WIDAR correlator were incorporated in the Observation Preparation Tool (**OPT**) this quarter. The OPT will be released to observers for use in the EVLA's OSRO program on January 15, 2010. Release of the Observation Preparation Tool (OPT) for commissioning tests took place as well.

The Proposal Submission Tool (**PST**) was modified to support the submission of Shared Risk Observing programs for EVLA Early Science as planned this quarter. Still on plan to initiate the new joint system with a direct link from the new one-stop-shopping Science Web page in Q2, adopting of ALMA Project Data Model into PST in Q3, and separation of user database component of the PST in Q3.

For Data Processing and Analysis, **CASA version 3.0 released for ALMA** and for **EVLA.** A **dynamic CASA wiki tutorial** with guides and examples went live for ALMA. For **SKA, CASA** (Common Astronomy Software Applications) package adopted for KAT7 and MeerKAT commissioning and operations.

No activity is reported for Q1 for Pipelines and Algorithm R&D.

OSO Specific Milestones

- ***Observatory Statistics and Metrics***
  - Initial implementation of the new metrics registry/management dashboard complete (see Metrics)
- ***Archive and VAO***
  - Hosting of the Science Data Archive for EVLA on NGAS servers (see CIS)
  - Planning completed for first state installation of NA ALMA Mirror Archive (see ALMA)
  - Access to EVLA data is now provided by an Archive Access Tool (see EVLA)
  - 250 TB data storage added to GBT archive to support GUPPI data (see CIS)

This quarter, **the initial implementation** of the new metrics registry/management dashboard was completed. This will continue to evolve throughout this fiscal year to provide a systematic approach for continually improving the management dashboard and reports.

This quarter, NRAO began hosting the Science Data Archive for **EVLA on NGAS** servers. The planning was completed for the first state installation of the NA **ALMA Mirror Archive**. Access to EVLA data is also now provided by an **Archive Access Tool**. And **250 TB data storage** were added to GBT archive to support GUPPI data. This work can be reviewed in more detail in the CIS, ALMA and EVLA sections of this report. Work continues to complete the strategy for archive storage, including finalize planning and initiate implementation of a scalable system in Green Bank, Socorro, and Charlottesville and leverage existing resources at two national computing centers for hosting NRAO data by Q4.

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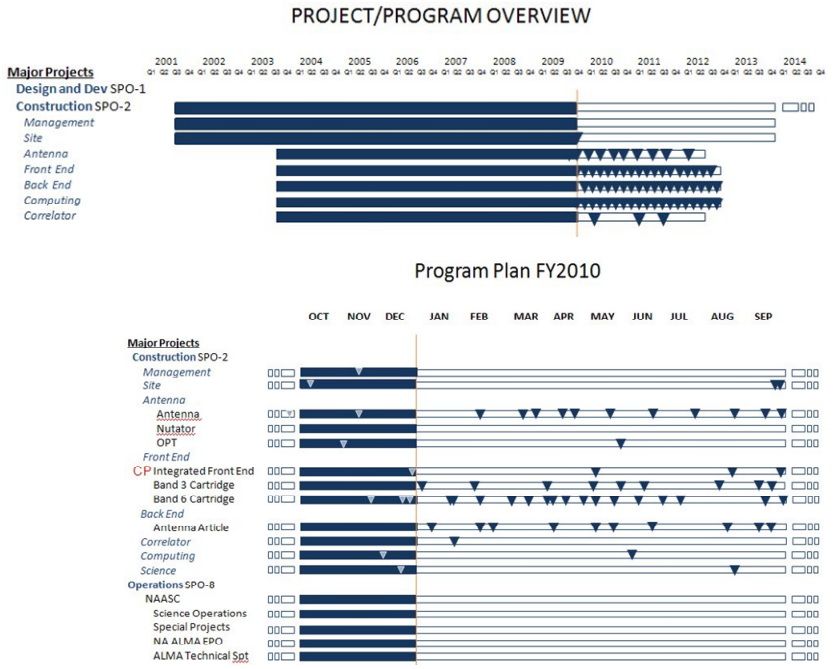
Atacama Large Millimeter/ Submillimeter Array (ALMA)

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

ALMA Construction Project Schedule View



Provided by: M. Pilleux/A. Russell

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***
  - Annual ALMA External Review
    - Held in Chile November 16-19, 2009
    - Positive feedback
  - Implementation of Cost-to-Complete exercise
    - Complete assessment of cost to go of all areas
- ***Site***
  - Execute the contracts for construction of the AOS power and fiber optic network
    - Contracts awarded and started execution; on schedule
    - Fiber optic delivered
  - Execute the contracts for AOS road construction
    - On schedule for Q4
    - Descope option considered for road surfacing

Provided by: M. Pilleux/A. Russell

MANAGEMENT: The **Annual ALMA External Review** (AAER) was held in Santiago, Chile November 16-19. The panel concluded that the management team of the JAO and the Executive Project Managers is strong, and works well together and indicated that the "achievement of fringes at the high site was an impressive feat". It also determined that the schedule is primarily threatened by two major deliverables: antennas from Europe, and front-end components from North America. The **Cost-to-Complete** exercise was initiated and resulted in a complete assessment of the cost to go in all areas. Following this exercise a series of parametric cuts have been initiated to restore the contingency to an acceptable level. ALMA succeeded in placing the **second NA antenna at the AOS** on November 20th, which allowed the achievement of phase closure on 25th November 2009.

SITE: The **AOS Roads and Utilities Contracts** were approved by the NSF and the work is under way. These contracts will install the necessary power and fiber optic lines to all AOS antenna stations. The complete AOS roads and utilities work is expected to require a total contingency release of ~6 M$, from a budget of 27.7 M$ to an estimated total for completion of ~34 M$. Savings of 3 M$ saving have already been obtained by descoping part of the AOS road surfacing specifications. The **procurement of FO cables** was approved, fabrication of the cables was completed, reception and QA were performed at the factory in Barcelona, Spain, and were delivered to Chile in Q1 FY2010, on time for the first milestone (Dec 2009). Delivery of **electrical transformers and switchgears** has started and will be completed on schedule during FY2010. The **ALMA Camp Extension** work to deliver ~150 new beds was finished Q1 FY2010. **AOS Roads Surfacing** bidding process is under preparation. The present budget now considers obtaining the aggregate inside the ALMA concession, expecting substantial savings. Power and FO was delivered to three additional **antenna stations** and two more antennas were installed there. **AOS road construction** is ongoing and presents a 40% progress.

ALMA Construction Specific Milestones

- ***Antenna***
  - Obtain acceptance for the Nutator Unit #1
    - Delayed to Q3
    - Responsibility for servo control system design and implementation was changed
  - Deliver to OSF of 4 Nutator units
    - Unlikely to meet Q3 deliver date due to changes in design and implementation of the control system
  - Delivery to OSF of 3 Optical Pointing Telescopes
    - First production OPT delivered in Q4 FY09; issues with CCD camera
    - OPT Unit #2 remains in the US for further testing
  - Acceptance of Vertex antennas
    - Fourth Vertex antenna accepted by ALMA

Provided by: M. Pilleux/A. Russell

ANTENNA: **Nutator Unit #1 acceptance** planned for Q1 FY2010 has been significantly delayed. As a result, change in responsibility for design and implementation of the servo control system has been made. A team at ASIAA led by Dr. Ming-Tang Chen has assumed responsibility for completing the nutator control system design. To date, significant progress has been made in identifying and resolving fundamental problems with the mechanical system stiffness and natural frequencies. The new expected acceptance date is Q3 FY2010. The **delivery of 4 Nutator units to the OSF in FY 2010 is unlikely** due to the substantial change in design and implementation of the control system. An update to the delivery schedule will be available once the major servo system design issues have been solved and verified. The first production **Optical Pointing Telescope was delivered** in August 2009 and successfully integrated into the ALMA software. Additional testing has uncovered that the centroid position on the CCD camera is sensitive to temperature gradients. Unit #2 has remained at the contractor's facility in Tucson, AZ for further testing to uncover the root cause of this temperature dependency. The **fourth Vertex antenna was accepted** into ALMA in Q1 FY2010 with continuing acceptance at 3 antennas per quarter. The goal of accepting 12 Vertex antennas in FY2010 is still being actively pursued.

ALMA Construction Specific Milestones

- ***Front End***
  - Front End Integration Center Management
    - Reorganized - FEIC Leader: Dr. Charles Cunningham; FE components group: Stefan Michalski
  - Critical design review of FE assembly postponed to Q2
  - Delivered one integrated NA FE to OSF
  - Delivered 8 LO Warm Cartridge Assemblies
  - 6 Band 3 cartridges completed and prepared for shipment
  - Delivered 3 Band 6 cartridges
    - Band 6 bandwidth will be increased to 5-10 GHz instead of 6-10 GHz, submitted change request
  - Delivered 5 production FE support structures

Provided by: M. Pilleux/A. Russell

FRONT END: The **FEIC in North America has been reorganized**. The **FE components** (including the items listed above) are no longer a responsibility of the FEIC team. Instead they have been separated out into a **separate group led by Stefan Michalski**. The FE Components team will have priority access to all the necessary staff in order to expedite delivery of the FE components (several staff were in common with the FEIC). Dr Charles Cunningham from HIA has agreed to take over as the **FEIC Leader** with the previous lead transitioning into a technical support role. The changes have been made with immediate effect. The **FE CDR was postponed** at JAO direction to Q2 in order to enable other activities, including a review of test procedures, to occur instead. Some **FE design verification tests** were postponed in order to resume unit article testing. **One integrated NA FE** was delivered to the OSF; 5 are scheduled for FY2010. **FE LO** and test source production (which compete for resources) are critical and are just keeping up with project needs. **8 LO Warm Cartridge Assemblies** scheduled for Q1 were delivered. LO Warm Cartridge Assemblies will be delivered in each quarter FY2010. **Band 6 production** resumed testing after determination that the cross-polarization measurements are not understood but the project can live with the present performance level. **3 Band 6 cartridges** were delivered. NRAO will deliver 24 Band 6 cartridges this fiscal year. It was agreed that the **Band 6 bandwidth will be increased** to 5-10 GHz instead of 6-10 GHz, and a change request was submitted. **Band 3 cartridges** were delayed by discovery of a SIS mixer fabrication problem which has now been solved. **6 Band 3 cartridges** were completed and prepared for shipment. A total of 24 Band 3 cartridges will be delivered this fiscal year. The first 5 of 25 **production FE support structures** were delivered, with the remainder expected to meet the goal in Q2. The **second FE test station** made good progress toward scheduled commissioning in Q3.

ALMA Construction Specific Milestones

- ***Back End***
  - Completed single dish timing rack to OSF
    - Delivered ahead of schedule on Q4 FY09
  - Deliver to OSF antenna articles
    - AA 11-20 were integrated, shipment delayed until Q2
    - AA 21-38 remain on schedule for FY10
    - Completed in Q1 Critical Design Review (CDR) of AA and DRX articles
  - Populate the final quadrant of the Correlator
    - Data Receiver Articles (DRXAs) have been delivered according to schedule for the first 3 quadrants of the Correlator
  - Complete Central LO Article #1 PAS Review
    - Passed in Q1

Provided by: M. Pilleux/A. Russell

BACK END: The **Single Dish Timing Rack (SDTR)**, an additional Central LO source for the antenna testing at OSF, was delivered earlier in Q4 FY2009. **Antenna Articles (AAs)** 11-38 are on plan for delivery this fiscal year. The AAs have been integrated in North America according to schedule but held up in order to increase batch size of shipments to the OSF (useful due to limited warehouse space). Immediately prior to the scheduled December shipment of AAs 12-20, the need for a firmware revision in some of the equipment was discovered. The revision was successfully implemented and shipment occurred in late January 2010. Future shipments will be further batched. **Data Receiver Articles (DRXAs)** have been delivered according to schedule for the first 3 quadrants of the **Correlator**. However, additional PCBs (which constituted nearly the entire article) are required to fully outfit the 4th Quadrant. Some of the printed circuit boards (PCBs) components are delayed, which in turn delay the PCB fabrication and work on the article. This is expected to push the delivery of the DRXAs into Q3. The delay is not expected to cause any problems for the Correlator as installation of Quadrant 4 is not scheduled until 2011. A **Critical Design Review (CDR)** was successfully held in November 2010 for the Antenna Articles and Data Receiver Articles. Action items are being tracked and resolved according to the schedule agreed to at time of review. The **CLOA1 (Central LO Article #1) Provisional Acceptance on-Site (PAS) review meeting** was held on 28 October 2009 and successfully concluded. CLOA1 is now in use at the AOS and supporting the ALMA commissioning work.

ALMA Construction Specific Milestones

- ***Correlator***
  - Completed checkout of second quadrant
  - Third quadrant delivery date of Q4 Rescheduled for Q2
- ***Computing***
  - ALMA software version R7.0 released
  - CASA version 3.0 released
- ***Science IPT***
  - Achieved closure phase at the Array Operation Site (AOS) earlier than planned

Provided by: M. Pilleux/A. Russell

CORRELATOR: In order to meet the project need for **operating 2 quadrants of the Correlator** simultaneously by April 2010, the delivery plan for quadrant 2 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.

COMPUTING: **ALMA Software v7.0** was released on 1 December 2009, as scheduled. Deployment testing and punchlist fixes continued through early January. While the deployment was more difficult than expected, it did not introduce any delay in the CSV start date. **CASA release 3.0**, the first non-beta release, was released about 3 weeks later than scheduled due to regression test failures which required investigation.s

SCIENCE: The Science IPT has continued to scientifically test the calibration and interferometric software tools implemented by the Computing IPT on the production ALMA system during initial Commissioning at the Array Operations Site. **Interferometry at the OSF** progressed, culminating in the demonstration of interferometric pointing. **PM03 antenna** was moved to the AOS and calibration and other software tools were tested. Pointing and refined holography established that Vertex antennas meet pointing and surface accuracy specifications over an extrapolated range of temperatures.

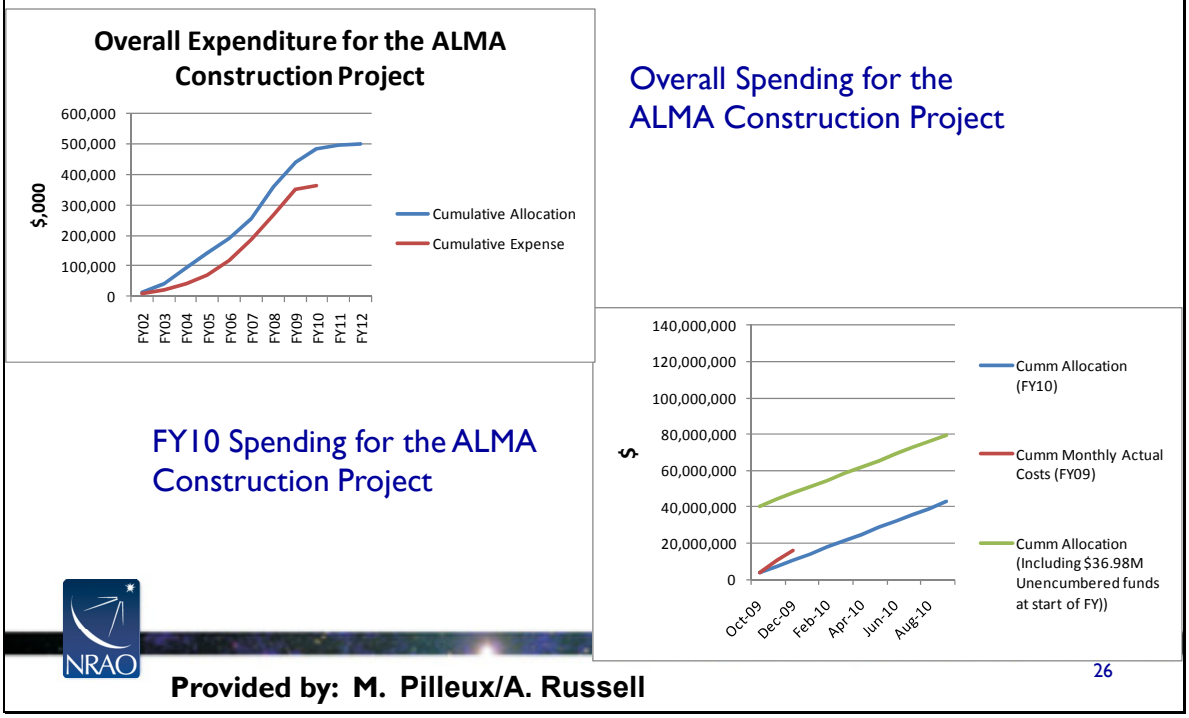
ALMA Construction (SPO-2) Significant Events

- ***Japan Partnership (SPO-7)***
  - Antenna Articles AA 12-19 were integrated, shipment delayed until Q2
  - LO Photonic Receiver Articles 17-24 on schedule for delivery in Q3
  - Subarray Switches and Line Length Correctors for Central LO Article
    - 8 final units awaiting end of procurement process
  - Band 3 OMTs delivered to HIA for use in cartridge production
  - Band 6 cold cartridge supplied to the EA FEIC and construction continued
  - WCA LO drivers delivered to EA FEIC *via* the cold cartridge manufacturers for Bands 3, 6, 7, and 9
  - Frequency multipliers and WCA LO drivers of revised design
    - Delivered to Band 4 and Band 8 cartridge manufacturers
    - Successfully proven to meet requirements
  - Components for assembling the third EA FEIC FE assembly delivered

Provided by: M. Pilleux/A. Russell

JAPAN PARTNERSHIP (SPO-7): **Antenna Articles 12-19** were integrated and shipment delayed until Q2. The Manufacturing Readiness Review approval for the vendor production integration of the **LO Photonic Receiver Articles 17-24** was provided in November 2009. NRAO is currently receiving these units for test and delivery to the Front End Integration Centers. Shipment of these units is expected in Q3 FY2010. **Subarray Switches (SAS) and Line Length Correctors (LLC) for Central LO Article** units 1-16 support the Central LO Article #1 (CLOA1) at the AOS, which already has 8 each of the units, but requires an additional 8 each for full functionality. The remaining 8 SAS units for the CLOA1 are in final integration in Charlottesville while the final 8 LLC units have been delayed due to a long procurement and NSF approval cycle for one key component. This is not expected to impact any science using the CLOA1 but will mean that 8 LLC units will be delivered in middle of calendar year 2010, about 3 months late compared to the Integrated Project Forecast schedule. Frequency multipliers and WCA LO drivers were **delivered to cold cartridge manufacturers** for use with all bands. The long-standing **issues** of LO power vs. LO noise for Bands 4 and 8 were satisfactorily resolved. Components for assembling Front Ends, including Band 6 cold cartridges, were delivered to all integration centers. Development of an LO driver/frequency multiplier combination for **Band 10** continued. 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 **third EA FEIC FE** assembly were delivered.

ALMA Construction Financial Performance Graphs – overall & Q1 FY2010



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) Significant Events

- ***Staffing***
  - Expats supported by OCA
    - One new expat arrived, one left, for a total of 22
  - ALMA local staff
    - 14 new hired, for a total of 191
- ***Activities***
  - Negotiations with the Union
    - Started in December following non-regulated mechanism
  - Purchase Orders processed
    - 141 - 879 k$ for NA ALMA Construction
    - 189 - 978 k$ for ALMA Operations

Provided by: E. Hardy/M. Pilleux/C. Lonsdale

One new expatriate arrived and one expat left, maintaining the total number at 22. OCA has reviewed and signed a total of **14 new ALMA Local Staff contracts** on behalf of the NA Executive, designated as the sole employer of Local staff for ALMA in Chile, bringing the total number of employees for which OCA provides ALMA with legal, payroll and travel support to **191 local staff**. OCA was heavily involved in the union negotiations that will extend into Q2. The Union accepted negotiating in a non-regulated way, i.e. not subjecting the process to the more stringent regulated legal mechanism. OCA has provided the legal and institutional support for contracts and procurements for ALMA as follows: a total of **141 purchase orders were made for ALMA Construction (879 k$)** and **189 for ALMA Operations (978 k$)**. 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. Monthly reports were issued to CONAMA (environmental authority) related to flora/fauna and archaeological follow-ups.

ALMA Science Operations (SPO-8) Significant Events

- ***Science Operations***
  - The new Science User web pages went live, and a dynamic CASA wiki tutorial with guides and examples went live
  - Planning completed for first stage installation of NA ALMA Mirror Archive
  - First draft NSF proposal for FY 2012-15 ALMA Operations completed
    - Participated in new task: JAO-led revision of the ALMA Operations Plan
  - NAASC staff rotations to Chile continued; participated in first fringe detection
  - Responded to October Science Operations Review panel report
  - Tested CASA, Observing Tool, Helpdesk
  - Hired developer for Helpdesk and User Portal integration effort

Provided by: C. Lonsdale/J. Hibbard

The new **Science User webpage** was developed, extensively reviewed and deployed in December on plan, in readiness for the January AAS meeting.

Planning was completed for the first stage installation of the **NA ALMA Mirror Archive**; racks were ordered and job requisitions for archive support staff were posted. Initiation of the NA ALMA Mirror Archive will continue through Q2 and Q3.

The first draft of the NSF proposal for FY 2012-16 ALMA Operations was completed and circulated for internal NRAO review, and to the ANASAC. Submission of a NSF proposal for FY 2012-16 ALMA Operation will be complete by Q3. The JAO initiated a new task: **revision of the AOP** which is due for completion in Q2. The ARC manager participated heavily. Risk: delay to development of budget for NSF proposal. No mitigation.

NAASC staff rotations to Chile continued. This milestone moved forward into FY2009Q4, which is when the first liaison scientist began work in Chile.

A response was formulated for the October **Science Operations Review** panel report, which recommended that the Department of Science Operations (DSO) in Chile should make improvements to the integrated schedule for operations software development, testing and documentation. The response was developed by the DSO with involvement of the NAASC and the other ARCs, and it described a plan to implement the recommended improvements.

User software was tested for **CASA**, the **Observing Tool** and the **Helpdesk.** User software testing and initial documentation will be complete by the Early Science decision point, late in the fiscal year. Many new functions were added to CASA, which was released in first non-beta form. The Technical Review forms were prototyped. NAASC developed and deployed the casaguides wiki with CASA use cases and scripts this quarter: http://casaguides.nrao.edu, and participated in a Santiago CASA workshop.

A developer was hired for deployment of the **ALMA Helpdesk and Portal.**

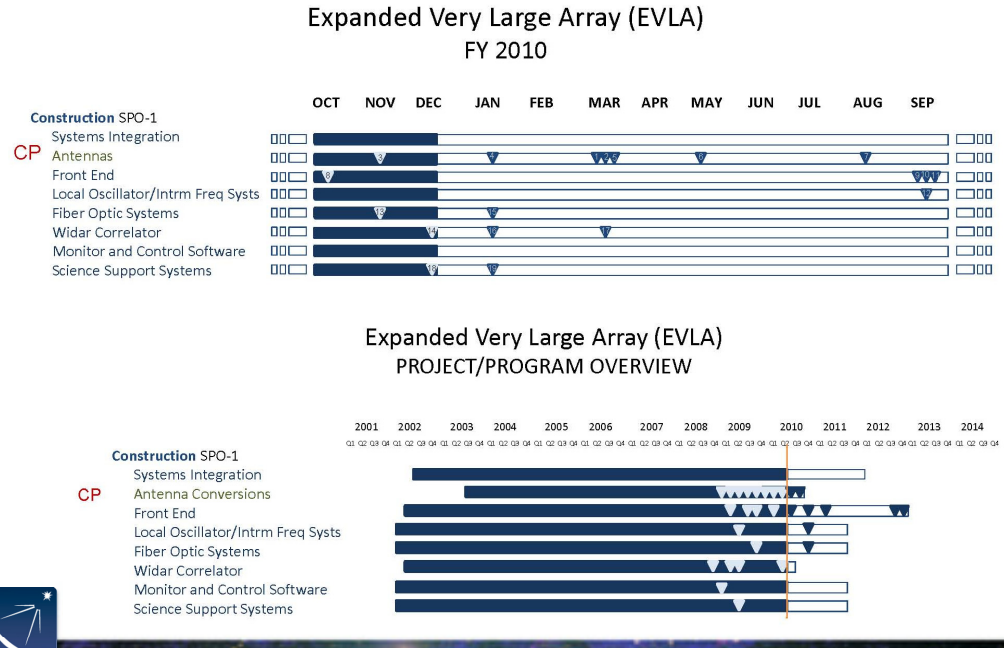
Agenda

- 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 I

EVLA (SPO 1) Complete Project Schedule View

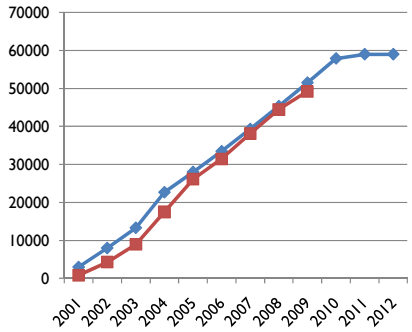


NRAO

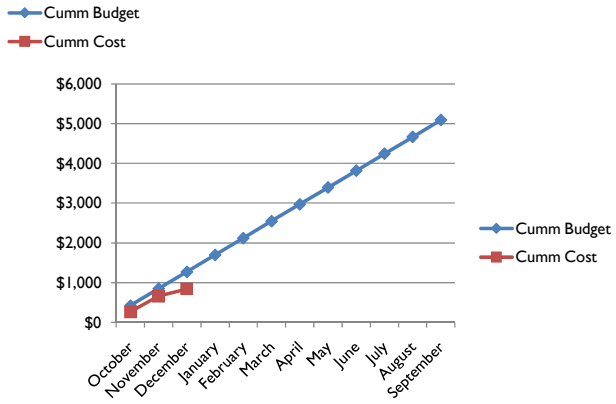
Provided by: M. McKinnon/B. Dickman

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 & Q1



Overall Spending for the EVLA Project



FY10 Budget/costs for EVLA Project

Provided by: M. McKinnon/B. Dickman

Spending in FY10 is slightly behind schedule due to the delayed deployment of X-band receivers and 3-bit sampler modules. See Front End and Fiber Optic sections for details.

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 $3.6M.

EVLA Construction Specific Milestones

- ***Systems Integration***
  - 24th and 25th antennas converted
- ***Antenna***
  - Mechanical overhauls completed for 24th and 25th EVLA antennas
- ***Front End***
  - Final design of the X-Band OMT was selected
    - X-band receiver production proceeding
  - Production and installation of EVLA K- (18-22 GHz), Ka- (26-40 GHz), and Q-band (40-50 GHz), L-Band (1-2 GHz), S-Band (2-4 GHz), and C-Band (4-8 GHz) receivers are on track for completion per plan
- ***LO/IF***
  - Assembly of all local oscillator and intermediate frequency (LO/IF) modules is on track for completion by Q4 FY10

Provided by: M. McKinnon/B. Dickman

Systems Integration: The **conversion of antennas** to EVLA design is on track for completion by Q4 FY10. This quarter, the 24th and 25th antennas were converted. See milestones #3, #4 on Project Schedule View chart.

Antenna: The **mechanical overhauls** for the EVLA antennas continue on schedule. This quarter, the 24th and 25th antennas were overhauled. Fabrication of X-band (8-12 GHz) feed horns will be complete on schedule in January 2010; see milestone #1. The completion of S-band feed horn fabrication is behind schedule by about one month, but this is not an issue since the number of horns on hand (25) is much greater than the number of receivers already built (6). Fabrication of S-Band (2-4 GHz) feed horns will be complete in April 2010. See milestone #2.

Front End: Final design of the **X-Band (**Ortho-Mode Transducer) **OMT** was selected. See milestone #8. The time required to select the OMT design for the X-band receiver delayed its deployment start date from Q2 to Q4, August 2010. However, the production and installation of the receivers are still scheduled for completion in December 2012. This eliminates the most significant remaining technical risk to the project. The fabrication of the X-band horns will be completed by March 2010; much before they will be needed for receiver production. Production and installation of **EVLA K- (18-22 GHz), Ka- (26-40 GHz), and Q-band (40-50 GHz)** receivers are on track for completion in Q4 FY10. See milestones #9, #10, #11. The production and installation of the fully EVLA-compliant **L-Band (1-2 GHz) and S-Band (2-4 GHz) receivers will be complete in late 2012. The production installation of the C-Band (4-8 GHz)** receivers will be complete in late 2010.

LO/IF: The assembly of all **local oscillator** and intermediate frequency modules (LO/IF), including the round trip phase and downconverter modules, are on track for completion by Q4. See milestone #12. EVLA local oscillator racks will be relocated in the control building as part of the VLA/EVLA correlator swap in next quarter, early January 2010. Modification of the rack relocation schedule will avoid a planned one-week array shutdown in the future.

EVLA Construction Specific Milestones

- ***Fiber Optic***
  - The design of the 3-bit, 4Gsps sampler was finalized in October 2009
  - The assembly of all modules for the data transmission system completed
- ***WIDAR Correlator***
  - Circuit board production
    - All station boards were delivered by November 2009
- ***Monitor and Control***
  - Integration of initial WIDAR correlator modes with the EVLA M&C System

Provided by: M. McKinnon/B. Dickman

Fiber Optic: An external review of the de-multiplexer on the **3-bit, 4Gsps sampler** board was held on October 1, 2009, to evaluate alternative de-multiplexer designs because the current design did not perform as expected. See milestone #13. The design was finalized in October 2009, eliminating another significant technical risk to the project. The layout of the new sampler board is now complete. The production order for the boards should be placed by May 2010, and we expect the installation of the boards in the antennas to be complete by September 2011. The change in de-multiplexer design delays the availability of 8GHz observing capability, but it does not delay the overall completion of the EVLA project. The assembly of all **modules for the data transmission system**, except for the 3-bit sampler modules, was completed. Deformatters will be relocated to the WIDAR correlator during the correlator swap in early January 2010. See milestone #15.

WIDAR Correlator: All **station boards** were delivered in Q1 per plan. See milestone #14. A sufficient number of **baseline boards** are on hand for the WIDAR OSRO observations that will begin in Q2. Remaining baseline boards will be delivered in two shipments, one in each of January and March. See milestone #17. The VLA correlator is on schedule to be shut down permanently on 11 January 2010. See milestone #16. Hardware modifications to enable correlator swap will be made after that. Astronomical observations will resume with the new WIDAR correlator in March, Q2.

Monitor and Control: Integration of initial WIDAR correlator modes with the EVLA M&C System was completed.

EVLA Construction Specific Milestones

- ***Science Support Systems***
  - Setups for the WIDAR correlator were incorporated in the Observation Preparation Tool (OPT)
  - The OPT will be released to observers for use in the EVLA's OSRO program on January 15, 2010

Science Support Systems: Setups for the WIDAR correlator were incorporated in the **Observation Preparation Tool (OPT)** in anticipation of a revised OPT release to observers using the EVLA under the OSRO program in Q2. See milestones #18 and #19. The beginning of general user observing with the new correlator in March 2010 will mark the beginning of EVLA operations.

EVLA Science Operations: Significant Events

- ***EVLA Data Access***
  - Access to EVLA data is now provided by an Archive Access Tool
  - Link from the DSOC to the outside world was increased to 200 Mbps in Q1
- ***Proposal Submission Tool***
  - The Proposal Submission Tool (PST) was modified to support the submission of Shared Risk Observing programs for EVLA Early Science
- ***Shared Risk Observing***
  - The Open Shared Risk Observing (OSRO) and Resident Shared Risk Observing (RSRO) programs were advertised to the community

Provided by: C. Chandler/B. Dickman

EVLA data access: EVLA datasets are expected to be up to three orders of magnitude larger than any ever produced by the VLA by the time the EVLA construction project is complete. In order to provide access to these data for the user community requires modifications to the VLA archiving system and increased bandwidth for data downloads. The **Archive Access Tool** (AAT) was modified during 2010 Q1 to provide access to EVLA data as well as VLA data, and also to include some amount of pre-processing of the data to reduce dataset sizes by averaging in time and frequency. At the same time the link to the outside world from the Domenici Science Operations Center was increased in speed from 20 Mbps to 200 Mbps during Q1, with plans to increase this further to 1 Gbps in Q2.

Proposal Submission Tool: The mechanism by which users submit proposals for EVLA time is the **Proposal Submission Tool (PST).** The PST was modified to support the submission of Shared Risk Observing programs for EVLA Early Science: OSRO, RSRO, and ECSO proposals, for all EVLA proposal types (regular, large, and rapid response) in Q1 in preparation for the October 1, 2009, proposal deadline.

Shared Risk Observing: Access to the EVLA is provided by two shared risk observing programs for the user community (**OSRO and RSRO**), and one for EVLA commissioning staff (ECSO). These programs were advertised to the community for the October 1, 2009, proposal deadline; the observations are planned to begin in 2010 Q2.

EVLA Science Operations: Significant Events

- ***CASA***
  - The first public version of CASA was released on schedule
- ***Observation Preparation Tool (OPT)***
  - Release of the Observation Preparation Tool (OPT) for commissioning tests took place

Provided by: C. Chandler/B. Dickman

CASA: The reduction of EVLA data is expected to be primarily via the Common Astronomy Software Applications (**CASA)** package. The first public release of CASA (version 3.0.0) took place in 2010 Q1 as planned.

Observation Preparation: EVLA observations will be prepared using the **Observation Preparation Tool (OPT)**. Testing of the OPT for OSRO observations took place during Q1, with plans for the first public release in Q2 in preparation for Early Science observations. End-to-end testing and verification of OSRO observing modes are planned for Q2.

OSRO tests: The VLA correlator shutdown was planned for Q2 (and took place as scheduled); at this time, testing of the observing modes being offered for Open Shared Risk Observing is planned to begin in Q2, in preparation for Early Science observations.

(E)VLA Operations: Significant Events

- ***ARRA Funds use in process***
  - Completed purchase orders for
    - track repair materials
    - tamper and tie puller
    - Azimuth Bearings
    - Transformer and spare dry-type Transformer
- ***Engineering Services***
  - Moved into D array as scheduled
- ***Computer Infrastructure***
  - Upgrade VLA-DSOC link to 1 Gbit/sec [Q1]

Provided by: P. Perley/B. Dickman

ARRA funds: These funds are currently being used to purchase **track repair material**, a **tamper and tie puller**, **Azimuth Bearings**, and both a **transformer** and **spare dry-type Transformer**. In addition, ARRA funds have been requested to repair the Visiting Scientists Quarters (VSQ) sprinkler System or to retire the VSQs.

Engineering Services: The array was moved into the **D configuration** as scheduled this quarter. It will be reconfiguration into C-array and B-array in Q2 and Q4. Azimuth Gear boxes on antennas #6 and #7 on plan to be replaced by Q4. 5000 ties will be replaced, per plan, along the ~ 44 miles of array tracks by Q4.

Computer Infrastructure: NRAO internal work has been completed for this milestone to upgrade the **VLA-DSOC link** to 1 Gbit/sec this quarter. However, New Mexico Tech is having trouble providing promised connectivity to Internet 2 at full 1 Gbps bandwidth. We are currently operating at 200 Mbps, which supports our current requirements. New Mexico Tech expects to resolve their problem within the next few months. We do not anticipate an operational impact from the delay.

Agenda

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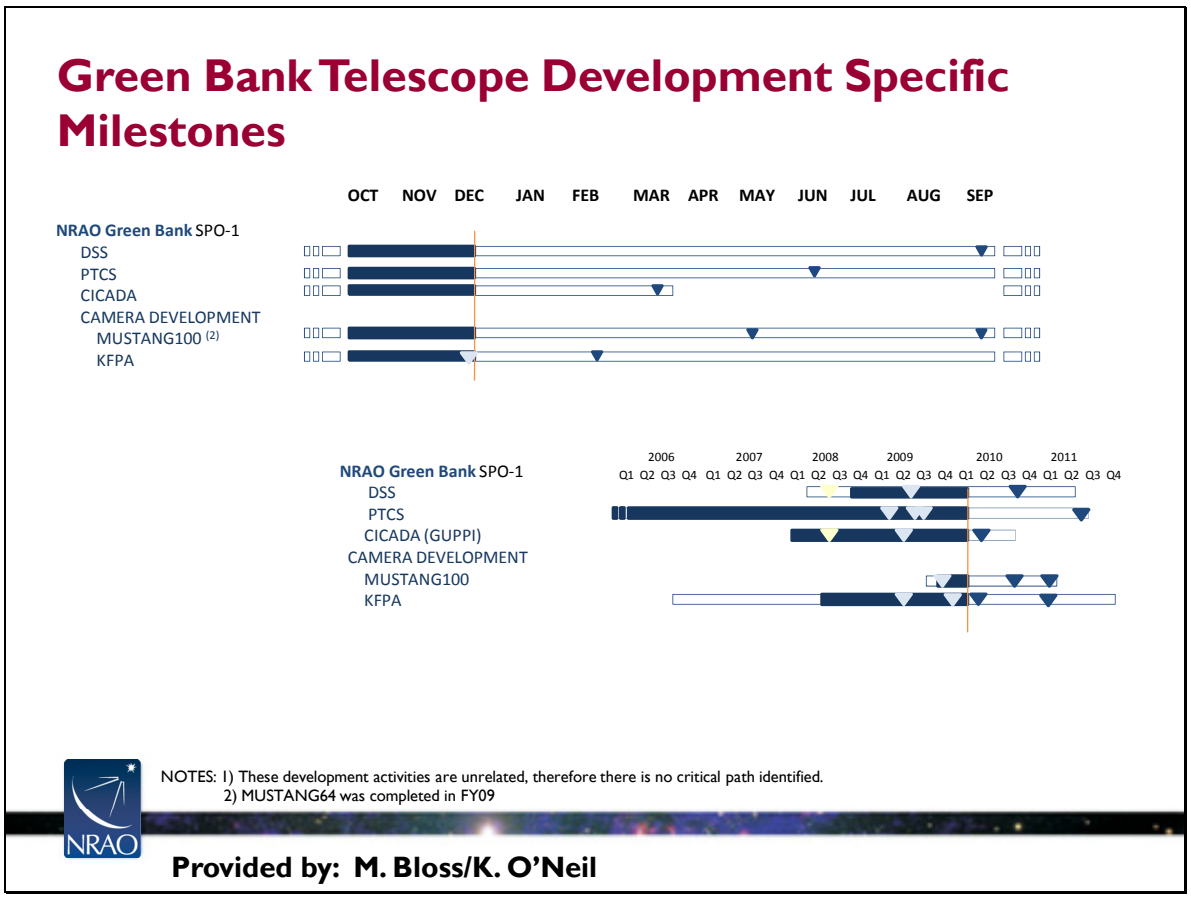


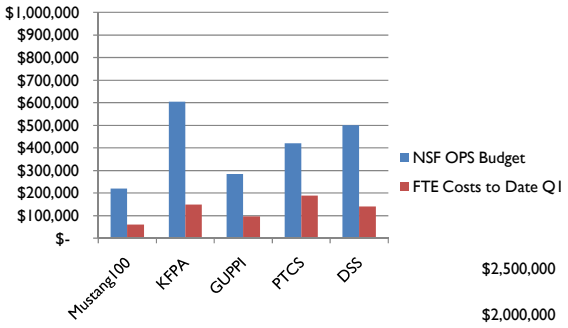
DSS: Work continues on the next major capabilities release in Q4FY10

PTCS: PTCS Surface work will complete in Q3FY10. Acceptance testing for the digital servo has been rescheduled for Q2FY11 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.

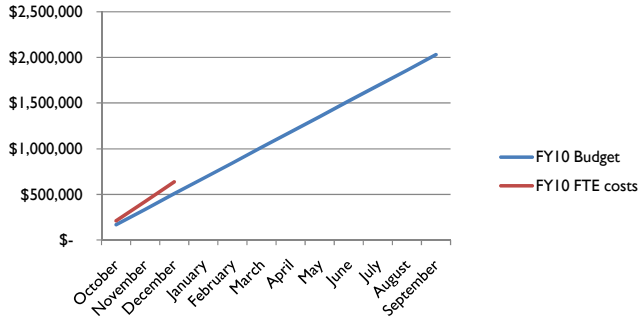
CICADA (GUPPI): As reported in the previous Qtr, the revised GUPPI schedule after funding was restored completes in Q2FY10.

Camera Development:
MUSTANG100: MUSTANG64 was completed as a project in FY09 and is in operation on the GBT. For FY10 we have established the MUSTANG100 project to track the potential upgrade to a 100-pixel array in the existing MUSTANG receiver. Mustang100 received and tested an array in Q3FY09 that was returned to NIST in Q1FY10. A replacement is hoped for Q3FY10, but the schedule is in NIST, not NRAO control (NIST is donating the array).
KFPA: Receiver construction completed and first cool-down complete in Q1FY09. Engineering tests will complete in Q2FY10, Commissioning in Q1FY11. These milestones were recast from the Program Operating Plan to fit better definitionally with the other NRAO sites, but the dates remain the same.
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

Actual expenses for Q1FY10 are inflated by untaken annual leave and an overrepresentation of salaries in the overlap periods between payroll periods and quarterly boundaries. The NRAO Leave Pool is an unbudgeted expense and untaken leave shows up as expense.

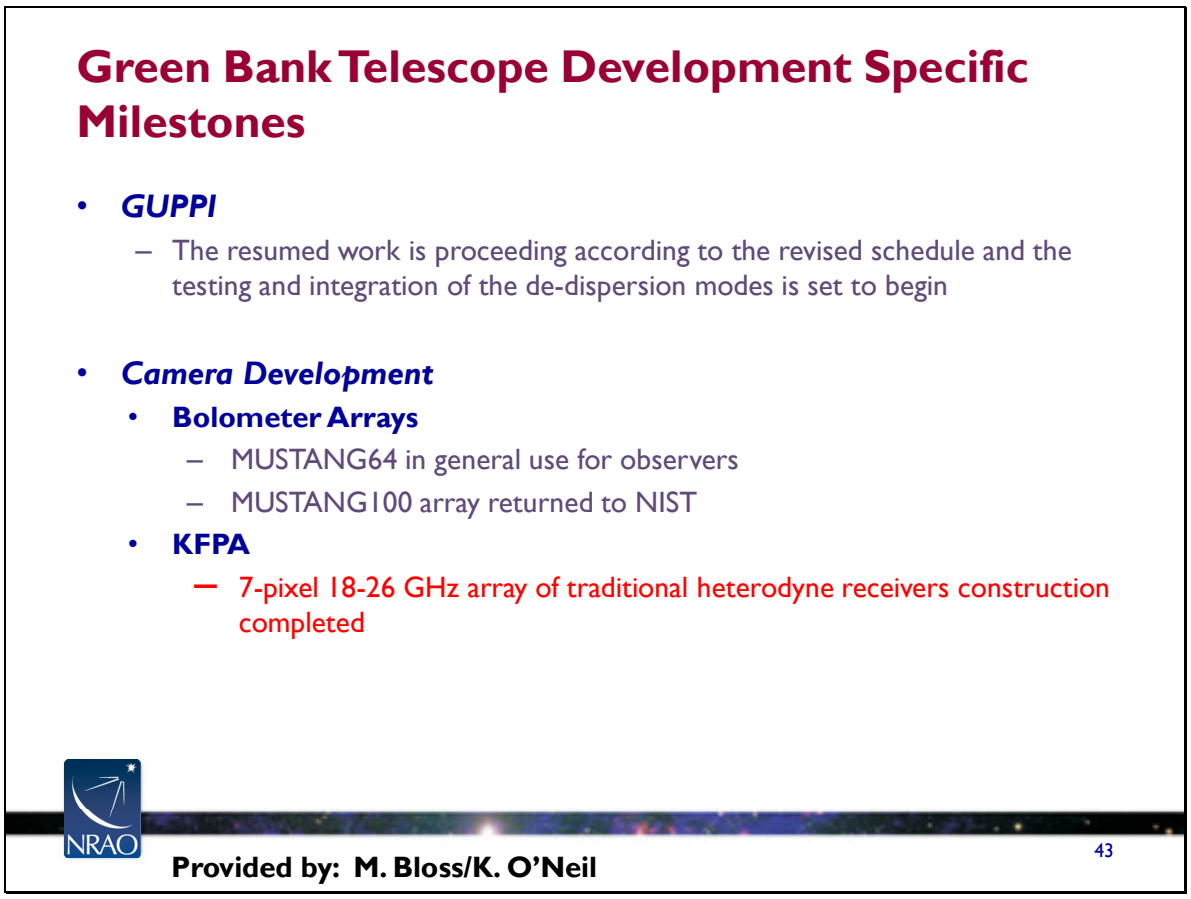
Green Bank Telescope Development Specific Milestones

- ***Dynamic Scheduling System (DSS)***
  - Release of the first version of the new DSS was complete
- ***PTCS***
  - Q-Band efficiency increased by a factor of 1.4, MUSTANG by 2.4 towards goal of providing a GBT aperture efficiency of 35% at 90 GHz (20% at 115 GHz)
  - Digital servo deployment delayed until Q2FY11 due to diversion of resources

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

Release of the first version of the new Dynamic Scheduling System (DSS) was complete this quarter. In spite of the loss of a key software developer for the DSS project in Q4 of FY09 (1/3 of the software team), the team continues to do interim software and algorithm fixes and enhancements in anticipation of a major functionality release in Q4 FY10.

PTCS:
Surface: The surface improvements continued through Q1FY10. The **Q-band** gain curve was measured in October, demonstrating that the aperture efficiency has risen from 45% to 63% as a result of the surface improvements provided by the holography campaign initiated in January 2009. This increase of a factor of 1.4 was confirmed again in December by comparing the efficiency of the current surface with a "retro" version of the surface which emulates all the broken actuators that were present before the holography campaign began. Similarly, the measured increase in MUSTANG gain is 2.4. The goal of this project is to provide a GBT aperture efficiency of 35% at 90 GHz (20% at 115 GHz) by the end of Q3.
Servo: The **servo** work continues to achieve its planned milestone performance and will begin some installation in Q3FY10 but is unable to maintain the completion and acceptance testing schedule due to staff members diverted to work on other important operational issues and unscheduled telescope maintenance requirements. 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 Q2 FY2011 due to diversion of resources. 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. Although the schedule to achieve the associated milestones is slipping, the performance at the various milestones is meeting spec and expectations. The PTCS work is so fundamental to the GBT strategic future, it must be completed, even if operational funds are required.



CICADA (**GUPPI**): The resumed work is proceeding according to the revised schedule and the testing and integration of the de-dispersion modes is set to begin. The work was halted in FY09 due to a lack of funding. When funding was restored, a revised delivery date of Q2 for coherent de-dispersion mode was published. This date is still on schedule for being completion of the capability. This is in accordance with the POP milestone table and narrative. The completion of the GUPPI pulsar backend and the De-dispersion modes will be tested and ready for integration and release in Q2. GUPPI is still on track for completion by end of the fiscal year.

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), and the instrument, **MUSTANG100**, will then be released for general GBT observer use. However, during this quarter, the MUSTANG100-pixel array was not able to be used for science and was returned to NIST for diagnosis of the failures. NIST believes they *may* have another array in the spring, but the timing is purely at the discretion of NIST as this is a voluntary effort on their part.

KFPA: 7-pixel 18-26 GHz array of traditional heterodyne receivers was completed this quarter. The receiver construction and cool-down was complete in Q1FY10 and lab tests are under way in advance of commissioning.

Green Bank Science Operations Specific Milestones

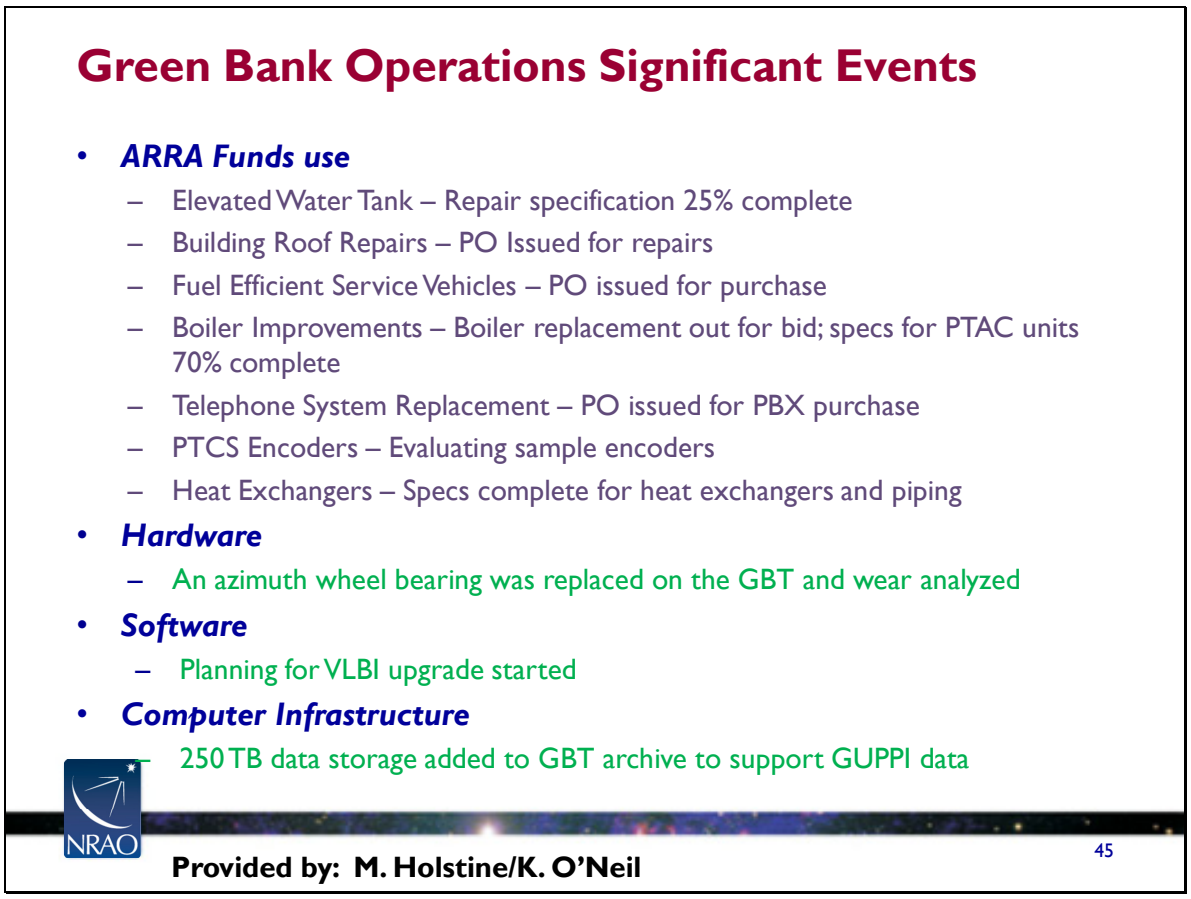
- Ongoing mitigation work on Ka correlation receiver to improve baselines for the Zpectrometer wideband spectrometer
- The replacement motor and drive system for the GBT turret motor delayed until Q3

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

The release of the Zpectrometer wideband spectrometer was planned for Q1, but that has been delayed. The **Ka receiver** has undergone a rigorous set of evaluative tests, including the CDL and key science community stakeholders, to identify the source of the baseline ripple issues. The evaluation team is reviewing results and will meet during Q2FY10 to decide the appropriate course of action going forward. Risk: The Ka Receiver and Zpectrometer were not available for observations in Q1FY10. Mitigation: Projects scheduled for the period the Ka Receiver was off the GBT will be rescheduled (if astronomical sources remain visible) when the evaluation team and GBT scientists agree the instrument is ready to be returned to service.

NRAO required the manufacturer of the drive system for the new **turret rotator** to perform an additional set of integration tests between the drive unit and the vendor-provided motor controller. This additional work has set back installation until Q2FY10. Risk: New motor drive proves unreliable resulting in significant GBT downtime. Mitigation: More extensive testing of the integrated drive unit by the manufacturer before acceptance of the assembly by NRAO.

Plans remain in effect to poll the GBT users in an effort to find ways to **streamline publication of GBT data** and science results. Start of this effort is dependent on filling open staff positions.



There is activity on all of the projects funded by the American Recovery and Reinvestment Act (**ARRA**). Purchase orders have been released for all or portions of three (3) projects and all others are in a specification or out for bid status.

The analysis of oils samples from one of the GBT azimuth wheels indicated a higher level of wear residue than normal. The **wheel bearing** was replaced with one from GB spares, the bearing area inspected for signs of wear, and the GBT returned to service. The removed bearing will be analyzed for wear, rebuilt, and returned as the GBT spare. (note: This is significant work since each GBT wheel carries >1 million pounds and the wheel bearing is >30" in diameter).

The Green Bank Software Development Division participated in a VLBI meeting in Mass. and is building a set of requirements, staffing plan, and implementation strategy for the changes that will be needed at the GBT to accommodate the **upgraded VLBI backend and storage systems**.

The new GUPPI pulsar backend has been well received by observers and handles virtually all new pulsar observations. The higher power system creates much more data than its predecessors and quickly filled the available storage provided for it. The **new data storage** provides a reasonable buffer for observers to store their data until it can be moved or reduced. This is one step of the NRAO data archive plan.

Agenda

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

VLBA Development Significant Events

- ***Sensitivity upgrade***
  - Distributed FX (DiFX) correlator full operational readiness completed
    - Full-time data reduction using DiFX correlator completed
  - All Digital Backend (DBE) support hardware design and development complete
  - Software tools for operator control of DiFX completed

Provided by: W. Brisken/B. Dickman

For the Sensitivity Upgrade project, the **Distributed FX (DiFX) correlator** achieved full operational readiness ahead of schedule in Q1. **Software tools** for operator control of DiFX was completed in Q1. **Full-time data reduction** using DiFX correlator is in effect. All **Digital Backend (DBE)** support hardware design and development is now complete.

Still on plan to complete a trial DBE installation at the Pie Town and Los Alamos sites in Q2. High speed data links connecting Socorro to the Pie Town and Mauna Kea sites are pending the MoU signing and are unlikely to be undertaken by the end of Q4. Design and production of all DBE support hardware is expected in Q3. Achievement of 2 Gbps record rate will double the sensitivity of the VLBA and will extend the reach of the VLBA to new scientific targets. Remaining work includes development of firmware for the new digital equipment, control software, and replication and installation of the hardware. The installation of DBE/Mark 5C recorder systems at all ten sites is anticipated by fiscal year closure.

VLBA Operations Significant Events

- ***ARRA Funds use***
  - Build and install Ka band receivers: Funding expenditures on hold pending signing of MoU between NSF, NASA and USNO
- ***Partnerships***
  - A Memorandum of Understanding between NASA, USNO, and NSF is in place NASA and USNO have not yet signed the MOU
- ***Engineering Services***
  - Mauna Kea received major maintenance visit by the VLBA Tiger Team
- ***Hardware***
  - Completed installation of security systems at Owens Valley and Hancock

Provided by: J. Ulvestad (Partnerships)P. Perley/W. Brisken/B. Dickman

ARRA Funds have been identified for the development and installation of the **Ka Band Receivers**. However, funding expenditures are on hold pending the signing of the **MoU between NSF, NASA and USNO**. The MoU was expected to be completed by Q1. The Draft MoU is complete and awaiting signature by NASA and USNO. Both agencies are committed to the development of the MOU, but found that they did not actually have committed funding when it was time to sign. Both agencies are being "worked" informally through several channels. In order to facilitate clearer impact statements for partnering agreements for the VLBA, a **WBS methodology** and cost allocation model was developed last fiscal year in order to provide VLBA-specific financial and FTE Projection and is now in use in Q1 FY2010.

In engineering, **Mauna Kea** received its major maintenance visit by the VLBA Tiger Team. All actions were completed without issue. Brewster, Hancock, and Fort Davis VLBA stations are scheduled to receive major maintenance visits by the VLBA Tiger Team in Q2 and Q3. Note that as of the writing of this document an Azimuth wheel needed replacement at Hancock as the old wheel broke January 3, 2010 and is currently being worked. An engineering and painting visit to Saint Croix is scheduled for Q4, as is a visit to repair the azimuth track at Brewster and North Liberty.

Security systems were installed this quarter by NRAO Environmental Safety and Security (see Management & Administration Infrastructure section of this presentation) at Hancock & Owens Valley. Security improvements will be completed on St. Croix, North Liberty, Brewster, Pie Town by end Q3.

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  - Management & Administration Infrastructure

Central Development Laboratory (CDL): Production, Upgrade and Repair/Maintenance

- ***Amplifier Production, Repair, and Development***
  - Delivered 18 new amplifiers to EVLA
  - Upgraded, repaired, and retested 7 amplifiers for the EVLA, GBT, and VLBA
- ***Electromagnetic Support***
  - Completed design of test transitions for X-band (8-12 GHz) measurements
  - EVLA Memo #140 titled "Design, Prototyping, and Measurement of EVLA Ku-Band Feed Horn" was released
  - Calculated subreflector scattered pattern of the GBT to verify ring-patterns caused by diffraction observed in the holography measurements at 11.7 GHz

Provided by: S.K. Pan/J. Webber

Amplifier Production: New amplifier production included **18 new amplifiers**: four 2-4 GHz, four 4-12 GHz, two 8-18 GHz, three 18-26 GHz, four 26-40 GHz, and one 38-50 GHz amplifiers. Repair, upgrade, and **retesting of amplifiers included 7 amplifiers for EVLA, GBT and VLBA**: two 4-12 GHz, two 18-26 GHz, and three 38-50 GHz amplifiers. In total, 25 amplifiers were shipped. The EVLA amplifier production is slightly behind schedule. However, no impact on the EVLA receiver production is expected. A total of 90 new amplifiers are on plan for delivery to EVLA by end of the fiscal year. The deliveries of 18-26 GHz and 38-50 GHz amplifiers in support of Korean VLBI network, MPI Receiver Group, and JPL DSN are on schedule.

The production task of delivering 22 new Ka-band (26-40 GHz) amplifiers to the VLBA is on hold and will be restarted after NASA signs the MoU.

Electromagnetic Support: Work continues on designing and prototyping components for completion of the EVLA and GBT receivers. These include: Completed design of test transitions for **X-band** (8-12 GHz) measurements, needed to verify performance before going to production; **calculated subreflector** scattering pattern of the GBT to verify ring-patterns caused by diffraction observed in the holography measurements at 11.7 GHz, needed to fully understand how to optimize the surface of the GBT for high-frequency observations; and wrote and released **EVLA Memo #140** titled "Design, Prototyping, and Measurement of EVLA Ku-Band Feed Horn" documenting the expected optical performance of the new EVLA 12-18 GHz receiver for comparison with measurements.

Central Development Laboratory (CDL): Research and Development

- ***Amplifier Development***
  - Continue research on noise properties of heterostructure bipolar transistors (HBTs) and CMOS MOSFET
  - A 12-18 GHz amplifier with new substrate design has been built and evaluated
- ***Electromagnetic Component Support***
  - Developed a corrugated phase shifter to operate from 38-50 GHz
- ***Millimeter & Submillimeter-Wave Receiver Development (R&D only)***
  - First wafer of 700-μm SIS mixers failed DC testing
  - 700-μm mixer test set under construction
- ***Advanced Receiver Development***
  - Digital Ortho-Mode Transducers (OMTs) tested with better than 40 dB isolation
  - Prototype Digital Sideband-Separating Mixer with integrated Analog-to-Digital Converters (ADC's) is complete
  - The performance of different GBT W-Band focal plane array configurations are being analyzed as part of the Focal Plane Array project

Provided by: S.K. Pan/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 12-18 GHz amplifier with new substrate design has been evaluated. Also, a new task, design of a room temperature **230-470 MHz amplifier for the EVLA,** has been started.

In the area of Electromagnetic Component Support, this quarter a corrugated phase shifter was developed to operate from **38-50 GHz** for the EVLA Q band receiver. This is intended to improve the frequency range over which this receiver can provide useful polarization measurements, compared to the older generation polarizer.

Millimeter & Submillimeter-Wave Receiver Development (R&D only): The first wafer of **700-μm SIS mixers** failed at DC testing. Suspected cause is that the SiO_2 layer was put down in two steps due to equipment failure halfway through processing. Second and third wafers did not suffer this processing failure and they are expected to be finished in early February. Precise measurement of Nb superconducting properties using cryogenic probe station in progress. Measurement of NbTiN superconducting properties underway. Construction of the test set to characterize the 700-μm and 350-μm SIS mixers is underway. Software to allow for semi-automated testing is progressing. Completion of the mixer test set is expected end of March, which should coincide nicely with the first availability of a 700-μm SIS mixer block. This work is supported in part by the ALMA Operations.

Advanced Receiver Development: The first prototype 3-probe and 4-probe versions of the **Digital Ortho-Mode Transducer** (DOMT) have been tested successfully. This not only proves the concept for the 3-probe version whose feasibility was not intuitively obvious, but shows excellent initial results with better than 40 dB linear polarization isolation. Circular polarization has not yet been synthesized from the data due to an error in the phase calibration equations, which we are now in the process of tracking down. The prototype Digital Sideband-Separating Mixer (DSSM) with integrated **analog-to-digital converters** (ADC's) is complete and awaits testing.

Design concepts and performance parameters for a GBT W-Band (68-116 GHz) focal plane array are under discussion. This remains a paper study since there is no funding for such an array at this time.

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

- ***Phased Array Feed (collaboration with Brigham Young University)***
  - Designed and measured thermal transition from cooled LNA to uncooled array dipole
  - Designed array element for optimum noise match with embedded impedance (BYU)
  - Verified on-sky predicted noise performance of individual and embedded array elements (NRAO and BYU)
  - Designed 19-element cryogenic array dewar
- ***PAPER***
  - **32 elements now deployed in Green Bank**
  - Satellite downlink antenna measurement system completed; calibration underway
  - Initial detection of ionosphere-induced source position offsets detected in Green Bank (1)
  - Gain-o-meter deployed in Green Bank; receiver modelling underway (1)
- ***Broadband Active Feed (R&D only)***
  - Initial evaluation of 1-3 GHz sinuous feed completed (1)
  - Fabrication of components for cryogenic version completed

NRAO

Provided by: S.K. Pan/J. Webber

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Phased Array Feed: To better define the R&D activities of this task, the name of this project, Beam Forming Array, has been changed. It is now called "**Phased Array Feed**". This quarter, designed and measured **thermal transition** from cooled LNA to uncooled array dipole, designed array element for **optimum noise match** with embedded impedance (BYU), **verified on-sky predicted noise performance** of individual and embedded array elements (NRAO and BYU), and designed **19-element cryogenic** array Dewar.

The Precision Array to Probe the Epoch of Reionization (PAPER), (collaboration with UC Berkeley): The 16 element array in South Africa deployed in late 2009. Fabrication of additional 24 components completed and large items shipped and **32 elements** are now deployed in Green Bank. Satellite downlink antenna measurement system completed; calibration underway. Initial detection of **ionosphere-induced source position** offsets detected in Green Bank. The **Gain-o-meter** is a special element of PAPER. This element is located near the center of the array and has the same thermal properties as all of the other elements, but its antenna is not connected electrically to the amplifier. Instead, the amplifier's input is terminated by a load resistor. The physical temperature of the load, amplifier, cable, and receiver for this element are recorded once per minute during an observation. The autocorrelation from this element together with the temperature information is used in a parameterized model of our system to correct for long term gain variations across the array. The Gain-o-meter gives us an order-of-magnitude improvement in gain stability.

Broadband Active Feed: This is a new CDL-Dynamic Spectroscopy Lab R&D task. Initial evaluation of **1-3 GHz sinuous feed** completed. Fabrication of **components for cryogenic version** completed. Two technical papers submitted for publication.

FASR: The proposal for the FASR Pathfinder was not successful. This Task has been terminated and will not be reported in the future Quarterly Status Update.

(1) Graduate student project

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New Initiatives- Square Kilometer Array (SKA)

- SKA Program Office added additional FTEs (0.4) for development of KAT-7 and MeerKAT as true SKA precursors
  - SKA-like "industrial commissioning" model accepted, and detailed commissioning and operations transition plan for KAT-7 being solidified
  - CASA (Common Astronomy Software Applications) package adopted for KAT7 and MeerKAT commisioning and operations
- Initiated substantive discussions on the SKA Dish Verification Program (DVP) with US and international partners
  - Most likely test site for DVP is at the EVLA
  - Possible larger role for NRAO in engineering management

Provided by: J. Ulvestad

SKA Program Office added **0.4 FTE** by detailing Debra Shepherd to South Africa SKA Project for several activities such as development of "**industrial commissioning**" model on KAT-7 and MeerKAT telescopes; remainder of her salary is paid by South Africa (0.5 FTE) and ALMA (0.1 FTE). She formally started work in SA October 1. "Industrial commissioning" implies much more automated rollout of complete antenna systems. It is a critical technique that must be developed for SKA to succeed, since the testing of 3000+ antennas cannot be handcrafted as has been done for all previous interferometers; the peak rate of antenna rollout for SKA (~2/day) is ~100 times faster than EVLA (~1 per 2 months). Thus, a combination of capabilities such as automated procedures and testing antennas/components in batches, executable by operations personnel rather than expert scientists, must be developed as an end-to-end process that we have dubbed "industrial commissioning." The goal is to develop this process and test on MeerKAT (80 antennas to be rolled out, with peak rate faster than 1/wk).

NRAO's **CASA** (Common Astronomy Software Applications) package was adopted for KAT7 and MeerKAT commisioning and operations in this quarter. This is relevant because CASA is the software package being used for ALMA and EVLA data reduction; especially in the case of EVLA, there is a chance that algorithms useful to EVLA (and eventually SKA) may be developed and/or tested by the South Africans for MeerKAT.

Participated in numerous meetings and telecons on SKA **Dish Verification Program** (DVP), including attempts to stimulate US Technology Development Program (TDP, run by US SKA Consortium and funded by NSF) to clearly define requirements and test plans. A successful DVP is perhaps the "signature" deliverable from the TDP, without which NSF will likely consider DVP to be a failure. It also is a key deliverable of the PrepSKA effort funded by the European Commission, and PrepSKA is counting on the deliverable from TDP. Many of the DVP discussions have focused on having NRAO take on a larger role in engineering management, of the DVP.

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Education and Public Outreach

- Green Bank Education Officer promoted to Senior Education Officer
  - overseeing unified Education efforts Observatory-wide
- Work underway to develop EPO Media Production Studio and hire science writer
- Documentary videographers shot historic move of 1st North American ALMA antenna from OSF to AOS
- ViewSpace systems have been delivered to Green Bank Science Center and VLA Visitor Center (but not yet installed)
  - will enable exhibit content about all NRAO sites to be displayed at both centers

Provided by: J. Stoke

As part of EPOs effort to transition to a more unified, "one Observatory" organization in FY 2010 that will cut across facility divisions, in Q1, Green Bank Education Officer, Sue Ann Heatherly was promoted to **Senior Education Officer,** overseeing unified Education efforts Observatory-wide. We will be recruiting an Education Specialist in Green Bank to handle more of the day-to-day interactions with visitors and students, as well as pursue grant funding for STEM education projects. In addition, work got underway this quarter to develop **EPO Media Production Studio** and hire a science writer.

As part of NRAO's efforts to create programming about radio astronomy, in Q1, EPO funded travel for **documentary videographers to shoot a historic move** of the 1st North American ALMA antenna from OSF to AOS. During the Vertex antenna move shoot, NRAO had two camera teams on site, coordinating efforts to develop the best coverage for a possible future broadcast documentary.

In an effort to supplement the GB Science Center's exhibits with content that describes other NRAO facilities, including ALMA, **ViewSpace** systems have been delivered to both centers, but not yet installed. (Pan-NRAO content will be created for this system in future quarters.) New outdoor wayside signage at the VLA Visitor Center will also address other NRAO facilities (to be developed in future quarters).

NRAO Q1 efforts to increase the dissemination of the press releases and associated media resulted in researching means for PR distribution in Europe which will be implemented next quarter. Work is still on plan for the development of an ALMA exhibit panel for display at the Smithsonian's National Air and Space Museum, and on the enhancement of the public website before the end of the fiscal year. The public website development is awaiting web resources that will be freed-up upon completion of non-public science website, and arrival of our new science writer.

Education and Public Outreach (2)

- Pulsar Search Collaboratory student Lucas Bolyard honored at White House by the president during Int'l Year of Astronomy ceremony & Star Party
- Two science press releases:
  - VLA observation of most distant GRB
  - NRAO participation in global VLBI geodesy experiment
- Green Bank Telescope featured in Wired magazine
- Organized various visits, open houses, and tours
- Several grants submitted and/or awarded

Provided by: J. Stoke

EPO's scope is broad, and can include specific activities that are not predictable and thus not explicitly detailed in the Program Operating Plan. In Q1, these accomplishments included: Pulsar Search Collaboratory student **Lucas Bolyard** honored at White House by the president during Int'l Year of Astronomy ceremony & Star Party. http://www.nrao.edu/pr/other/obama/. **Two science press releases:** (1) VLA observation of most distant GRB (http://www.nrao.edu/pr/2009/grbz8/) and (2) NRAO participation in global VLBI geodesy experiment (http://www.nrao.edu/pr/2009/bigvlbi/). Other notices in science press: Gamma Ray / Millisecond Pulsar link (http://www.sciencenews.org/view/generic/id/49198/title/Gamma-ray_sources_guide_astronomers_to_pulsars). We also supported (graphics, etc.) CfA Orion VLBA movie press release, November. Green Bank Telescope featured in Wired magazine. http://www.wired.com/wiredscience/2009/10/gbt-nrao-tour/.

Various **visits, open houses, and tours** this quarter included: VLA tour and interview for Albuquerque Journal , R. Perley and Finley P.I story 26 Dec. edition. By request in-depth, guided tour of VLA for U.S. Rep Harry Teague (D-NM) on 21 Dec. Enchanted Skies Star Party, October, with NRAO speakers and VLA tour. Tour of PVDSOC electronics lab for Socorro Hamfest attendees (Bill Brundage), October. VLA Open House, October. Guided tour for Lt. Col. Endicott of USAF Space Command, October. Finley lecture to Technical Communication class at NM Tech, October. Guided tour of St. Croix VLBA site for group led by USVI Lt. Governor, November. 2-day IYA open house event at GB (about 175 attending on Saturday evening, 500 attending on Sunday).

Grant activity for this quarter included: Langston, Heatherly submitted a Chandra EPO proposal ($44.8K) to develop a ViewSpace exhibit featuring the Crab Supernova Remnant and Pulsar-- status pending. Submitted (November) a proposal in partnership with the National Youth Science Foundation and were awarded (December) a grant from the West Virginia Department of Education and the Arts to continue the Governor's School for Math and Science. The science center received a matching grant of ~ 7.5K to advertise the GB Open House event.

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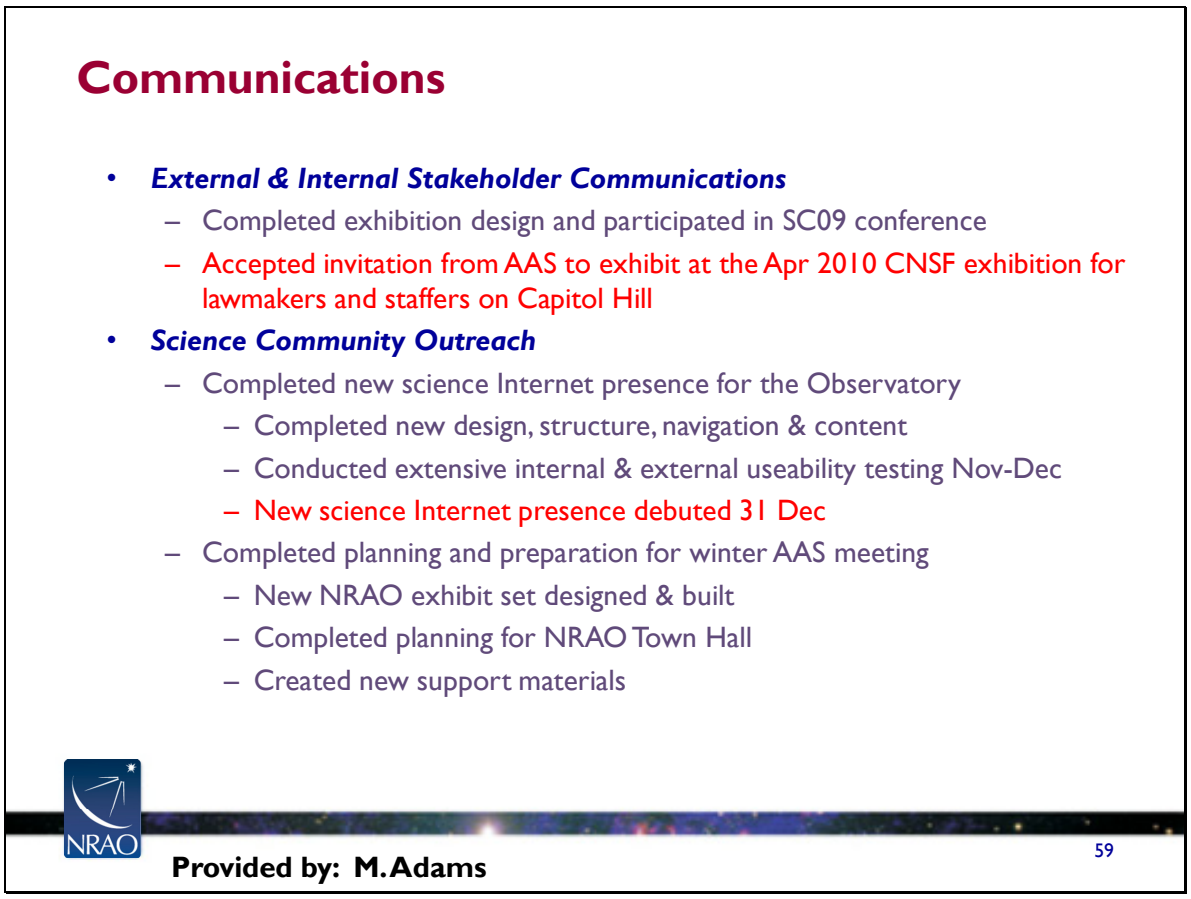

In the area of external stakeholder communications, a NRAO exhibition was debuted at the **International Conference for High Performance Computing, Networking, and Storage & Analysis (SC09)**. The conference was hosted at the Oregon Convention Center (Portland, OR) 14-20 Nov 09. Approximately 11,000 scientists, engineers, software developers, CIOs, and IT administrators from universities, industry, and government agencies attended. This NRAO exhibition was a CIS-COM collaboration. In addition, the NRAO accepted an invitation from **The American Astronomical Society (AAS)** to exhibit at the Apr 2010 the **Coalition for National Science Funding (CNSF) exhibition** for lawmakers and staffers on Capitol Hill. CNSF is a collection of science organizations that advocates for US support for science. The AAS is a member of CNS and sponsors one observatory every year to participate in a springtime exhibition for lawmakers and staffers on Capitol Hill. Images from the 2009 event are at http://www.cnsfweb.org/.

Efforts to make specific proposals designed to ensure more effective and accurate internal communication across the Observatory, including the design and deployment of a new internal web site (Intranet) structure, navigation, and content management system has not yet started but is still on plan for this fiscal year.

For Science Community Outreach, NRAO introduced a **new science Internet presence** for the Observatory. The science web site, http://science.nrao.edu, was completely redesigned, including its structure, navigation and content. All NRAO scientific staff were invited to participate in the internal useability testing; scientists from the community participated in the external testing. The new science web site debuted smoothly on 31 Dec 2009. The design for a new "NRAO Science Report" will start later this fiscal year but is still on track for initiation in Q3. During this quarter, NRAO completed

planning and preparation for the **winter AAS** meeting. New NRAO exhibit set and space was redesigned to create a more open, welcoming, and visually attractive space to interact with the community at the AAS meeting. New support materials included extensive video incorporated into the exhibition, the 2010 NRAO Research Facilities brochure, and NRAO-branded 2 GB flash drives with pre-loaded content.

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Spectrum Management

- ***General Spectrum Management***
  - ***Domestic activities***
    - HughesNet installers began coordination of satellite broadband installation in the NRQZ
    - Both Hughes and WildBlue now coordinate with NRAO under FCC rules for geographic area licensing
  - ***International***
    - Drafted coordination agreement between IUCAF and SFCG regarding high-power radars in low-earth orbit
    - Worked on program for the IUCAF Summer School on Spectrum Management for Passive Services, Mitaka, Japan, June 2010

Provided by: K. O'Neil/B. Dickman/H. Liszt

Domestic: Lack of cooperation on the part of commercial installers operating under (broad) geographic area licensing agreements has been one of the most difficult and persistent problems for NRQZ administration. However, both **WildBlue** and **HughesNet** responded affirmatively to letters from NRAO HQ reminding them of their obligations under the relevant FCC rule parts.

International: The earth-sensing community is making increasing use of powerful radars in low-earth orbit across the microwave spectrum and these could damage radio astronomy receivers if the radar passes too close to the radiotelescope boresight. A new **coordination agreement** between IUCAF and the Space Frequency Coordination Group (SFCG), similar to one formulated earlier for the 94 GHz cloud radar satellite CloudSat, will ensure that radio astronomy is made aware of these radars and provided with all relevant information required to avoid damage and identify possible RFI. During this quarter, worked on program for the **IUCAF Summer School** on Spectrum Management for Passive Services. The third IUCAF Summer School will be held in Mitaka in June 2010.

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Office of Science and Academic Affairs

- ***Management Activities***
  - AD for OSAA attended Women in Astronomy meeting in Maryland
  - Chief Scientist organized discussion on NRAO Science Meetings for 2010.
  - 2009 Jansky Lecture presented in Charlottesville
- ***Scientific Staff***
  - Associate Scientist, A, began appointment at GB w/ GB Sci Srvs
  - Associate Scientist, A, began appointment at CV w/ NAASC
  - Tenured Scientist in CV terminated appointment at NRAO
  - Scientist, A, in GB, converted to 50% part-time status.
  - Two Associate Scientists, RE, in CV and SO were promoted to Scientists, RE.
  - Staff member in SO appointed to scientific staff as Associate Scientist, CS
  - ***Jansky Fellowship Program***
    - Two more 2009 Jansky Fellows arrived to begin appointments
    - ***Four 2010 Jansky Fellowship offers were extended***

Provided by: T. Bastian

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Women in Astronomy conference provided good opportunity for NRAO Human Resources staff and Tim Bastian to network regarding diversity issues that affect women in astronomy. **Chief Scientist** organized discussion on Science Meetings for 2010 with other members of the scientific staff and provided results to the Director. The **2009 Jansky Lecture** was presented by *Anthony Readhead, Caltech*, in the historical Rotunda at UVA this October. It will be presented again in Socorro in January 2010 in conjunction with the annual New Mexico Symposium. See *http://www.nrao.edu/jansky/2009/readhead.shtml* for more info on the 2009 Lecture.

David Frayer from Caltech, returned to NRAO as an **Associate Scientist, A,** to work in GB. He was once a predoc in CV, and *Kartik Sheth* arrived in CV as an **Associate Scientist, A,** he's also from Caltech. *Juan Uson* left his **tenured Scientist** appointment for a position at the Observatoire de Paris-LERMA at the end of December. *Frank Ghigo,* **Scientist, A,** converted to 50% part-time status. *Walter Brisken* and *Mathew Morgan* were both promoted from Associate Scientist, RE to **Scientist, RE**. *Doug Tody* was appointed to the Scientist Track as **Associate Scientist, CS**, after review by the SPRC-CS and concurrence by the OSAA AD and the Director.

2009 Jansky Fellows *Glenn Jones* and *Nirupam Roy* began their appointments in October. Four **2010 Jansky** offers were made to *Caitlin Casey* from Cambridge, *Laura Chomiuk* from U Wisconsin, *Greg Halinan* from U Ireland, and *Desika Narayanan* from CfA. *Chomiuk and Halinan* have already **accepted** our offers.

Office of Science and Academic Affairs

- ***Student and Visiting Scientist Programs***
  - NRAO Summer Student Program
    - Inquiries and applications being received for the 2010 program
  - Co-ops
    - One student completed his appointment in Socorro.
  - Predocs
    - Five predocs continued with ongoing projects
    - Predoc won first place at 2009 IEEE competition
  - Graduate and Undergraduate Interns
    - Six students continue programs
  - Visiting Astronomers
    - Two new visiting scientists in Socorro
- ***Support Programs***
  - ***Student Observing Support***
    - Proposal Selection Committees completed review of 10A proposals

Provided by: T. Bastian

Summer Student Program: The program has ramped up, **receiving applications** and inquiries regarding the 2010 program. Deadline for summer 2010 is February 1, 2010. For more information go to *http://www.nrao.edu/index.php/learn/education/re.*

Co-ops: *Kenneth Johnson* completed a four-month appointment in SO in December.

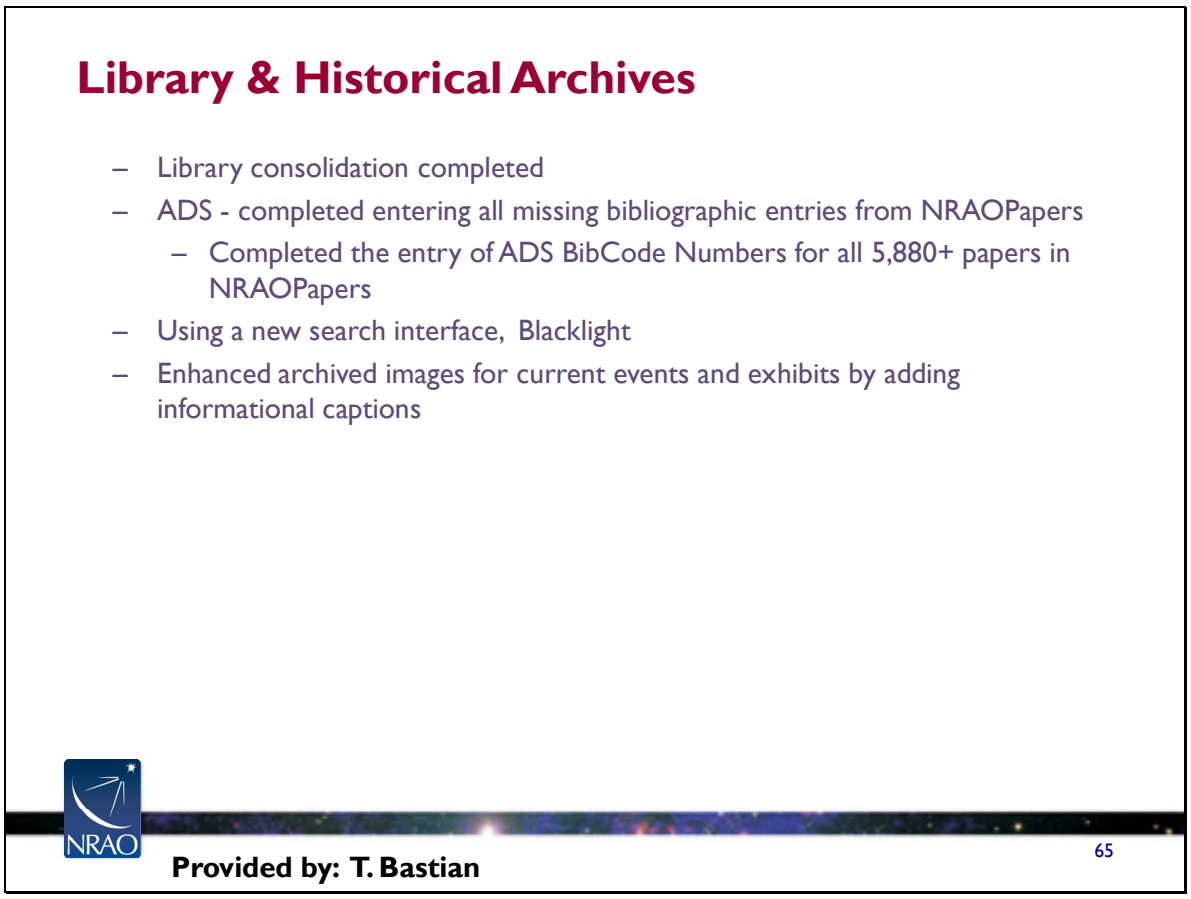
Pre-Docs: *Katie Mae Chynoweth* (Vanderbilt University) continued working with in Green Bank on HI observations of interacting galaxies with the GBT and VLA; *Rohit Gawande* (University of Virginia) worked at the NTC on development and fabrication of ultra-wide-band feeds for a variety of radio astronomy applications. Rohit **won first place** at the 2009 IEEE International Microwave Symposium's low noise amplifier design competition. The measured noise figure of Rohit's winning amplifier was 0.22dB (15K) at 2.45 GHz with a gain of 20 dB. Details of his design will appear in an upcoming issue of IEEE Microwave Magazine. *Cheng-Yu Kuo* (University of Virginia) continued working in Charlottesville on reducing and analyzing VLBI observations of water maser emission from galactic nuclei as part of the Megamaser Cosmology Project with Jim Braatz; *Urvashi Rao-Venkata* (New Mexico Tech) continued working at NRAO in Socorro on wide-band imaging algorithms and techniques with Frazer Owen; *Paul Ries* (University of Virginia) continued his work with Todd Hunter on PTCS in GB, funded by GB Operations.

Graduate Interns: *Abhirup Datta* (New Mexico Tech) continued a graduate internship working in Socorro on simulations of reionization and low frequency data processing; *Nimish Sane* (University of Maryland) continued a graduate internship working in Green Bank on digital processing for radio spectroscopy working with John Ford and is funded by GB Operations.

Undergraduate Interns: *Dana Sills, Scott Davidson, and Matt Tibbetts* (all New Mexico Tech) continued undergraduate internships working on EVLA electronics; *Emily Jones* (West Virginia University) worked at NRAO Green Bank as an undergraduate intern working on the construction of an encoder test fixture.

Visiting Astronomers: *Jake Hartman* and *Miriam Krauss-Hartman* were appointed Visiting Assistant Scientists in Socorro.

Support Programs: *Student Observing Support (SOS)* -the telescope Proposal Selection Committees completed their reviews of **10A-proposals**, now those proposals accepted for observing which include applications for SOS funding will be reviewed by the SOS Selection Committee for the potential awarding of funds.



The consolidation of the NRAO Library has been completed. Presentations were made at each site to outline changes and improvements to the NRAO Library offerings. Electronic subscriptions will be made uniformly available in favor of conventional print media.

We have provided to **ADS (**SAO/NASA Astrophysics Data System) the bibliographic information for all International Symposium on Space Terahertz Technology (ISSTT) conference proceedings (over 1500 papers). In addition, the NRAO Library is now supplying meta data from NRAOPapers to ADS (i.e., telescope name, proposal numbers, etc.), the bibliographic database of NRAO telescope and author papers. Completed the entry of ADS BibCode Numbers for all 5,880+ papers in NRAOPapers. With assistance from the NRAO IT group, the Library is now using **Blacklight** as the search interface for NRAOThesis and the ISSTT Web Pages, a search interface which is also used at the UVa Library.

Processing work continues on incoming materials to Archives. Archive materials being processed are post-1979 NRAO materials, on the papers of Marshall H. Cohen, on the papers of Ronald N. Bracewell, and recent past materials from the Director's Office. In consultation with NRAO scientific and engineering staff, **captions were prepared for a collection of photos** of the VLA construction, digitized from 33mm slides, for a future Web exhibit. The first of an ongoing monthly series of "*Photos from the Archives*" appeared in the December NRAO eNews. Archives web presence continues to grow.

Agenda

- Science Results/Metrics
- Observatory Science Operations
- Site Specific Activities
- Observatory-wide Operations
  - Central Development Laboratory
  - New Initiatives
  - Education and Public Outreach
  - Communications
  - Spectrum Management
  - Science and Academic Affairs
  - Computer & Information Systems
  - Management & Administration Infrastructure

Computer & Information Services

- ***Common Computing Environments (CCE)***
  - Production support for the Observer Helpdesk on track
  - Hired a User Portal Programmer
  - Active participation in the SuperComputing '09 conference
- ***Networking and Telecommunications***
  - Upgrade to NRAO CV Internet link to 1 Gigabit /second
  - Doubled Bandwidth into Green Bank and Socorro
- ***Digital Infrastructure***
  - Hosting of the Science Data Archive for EVLA on NGAS servers
- ***Security***
  - Network perimeter scan completed with no critical security faults
  - No production impacting incidents occurred this quarter

Provided by: D. Halstead

CCE: Production support for the **Observer Helpdesk** is on-track with go-live for EVLA support slated for March 1st using Kayako Helpdesk solution. The same solution is under consideration for ALMA regional support. On track with Development systems in place and **User Portal** programmer hired in support of the implementation of the web-based Content Management System and User Portal scheduled for Q4. ALMA is hosting a Plone training course in March in support of the User Portal as well. Two members of the computing staff and four researchers/engineers attended the SC09 High Performance Computing, Storage and Network conference in Portland OR.

Network: Commitment to upgrade ALL major sites to **1Gigabit/Second** to facilitate data access, complete for C'ville; A request for ARRA funding for GB-WVU is in final draft, due March 15th. In the interim Bandwidth to external networks for both Green Bank and Socorro has been doubled to 45, and 200 MegaBits/Second respectively. Quotes have been received for a replacement phone system in GB, planned for Q3.

Digital Infrastructure: The Next Generation **Science Data Archive** System servers have been installed in Socorro for EVLA go-live with duplicate servers to be shipped to C'ville once replication services are verified. ALMA archive servers are in the vendor bid process. Replacement Computer Room cooling on order for CV Archive systems in on track for implementation Q2. Six NGAS servers for ALMA, providing over 100 TBytes of storage is still on track for delivery in Q3.

Security: **Network Perimeter** scan found no critical security faults. No **production** downtime from security vulnerabilities occurred this quarter.

Computer & Information Services

- ***High Performance Computing***
  - Partnering with UVa on CASA speed-up
  - Employing clusters EVLA data and VLBA correlator
  - Utilizing GPU and FPGA technology for data acquisition
  - NRAO on Science Advisory Board for NFS TeraGrid
  - NRAO on review panel for eXtreme Digital award
  - Good representation at SC09 and on SC10 committee

Partnering with UVa on **CASA speed-up**. CASA developers, E2E and CIS have been collaborating with the University of Virginia Computer Science department (Andrew Grimshaw) to profile and optimize the CASA code within parallel architectures.

Employing clusters **EVLA data and VLBA correlator**. Leveraging Clusters of commodity servers for data analysis and high throughput software correlator for VLBA.

The GBT instrumentation team is aggressively employing highly parallel Graphics Processing Unit (**GPU**) architectures coupled to Field Programmable Gate Arrays **(FPGA**) Via 10Gigabit/second Ethernet.

NRAO is raising presence within NSF computing community; applying for time and storage on the **TeraGrid** and sitting on Office of Cyber Infrastructure panels and boards. NRAO on review panel for **eXtreme Digital award**.

Improved visibility and awareness of supercomputing community facilitated by active participation in the SuperComputing Conference series with good representation at **SC09** and on **SC10** committee.

Agenda

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  - Computer & Information Systems
  - Observatory Management Services

In Q1, a thorough review of NRAO's **compensation process**, including the grade structures and market surveys review and update of pay grades for exempt and non-exempt pay grades, was completed on schedule in the area of compensation. This is part one of a two-part process that will be completed in Q2.

Activities commenced in recruitment/applications tracking to develop a process for evaluating the effectiveness of **NRAO recruitment efforts**.

In Diversity Outreach, the Observatory Directory conducted an AD meeting in December focusing on recruitment efforts associated with diversity. An independent **diversity consultant** was engaged to facilitate the process. The development of an action plan began that builds a **diversity support network** from site level up to the Charlottesville headquarters, and assisted Howard University in further developing its astronomy program. Dr. Aaron Evans and Dr. Nicole Radziwill are working with Dr. Marcus Alfred to strengthen and enhance the Astronomy curriculum at Howard. We are working on having speakers from Howard present talks to NRAO and have NRAO staff present talks to Howard as well. We are also hosting two Howard University students this summer.

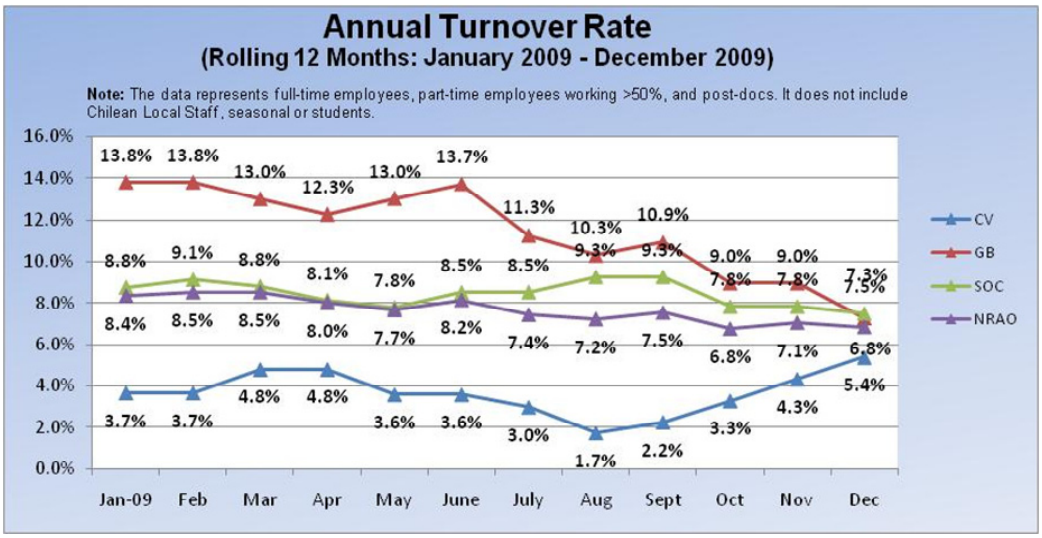
This quarter, there was one Diversity Employment **promotion**; a Sr. Public Education Officer female in Green Bank. There were six Diversity Employee new hires: Electrical Engineer II – CV (Female/Minority), Associate Scientist A – CV (Minority), Deputy Division Head – CV (Female/Minority), Telescope Mechanic III – SOC (Minority), Jansky Fellow – SOC (Minority), Sales Clerk – GB (Minority).

Observatory Management Services

- ***Human Resources***
  - ***Workforce Management Planning***
    - Observatory Staffing Plan (OSP) Development
      - Developed a model for collecting data to assess critical skills, optimized in synch with the NRAO Long Range Plan and Strategy
      - Modified a questionnaire used to collect information on critical skills
      - Identified gaps in the Observatory-wide FTE profile

Provided by: F. Giles/J. Firmani

During this quarter, the second meeting of the Observatory Staffing Plan Development team was held to further **develop the model which** will house data which will be used to assess Observatory critical skills and align them with future projects. Human Resources (HR), Administration, Science and Academic Affairs, and Observatory Program Management are all participating on this development team. A job description **questionnaire** was developed and sent to a small test group of managers and their staff asking for information that was deemed important in determining critical skills. This questionnaire was then modified after a test of the survey instrument showed areas for improvement. A second test will be initiated with the ALMA team to facilitate their staffing transition plan development. The team identified gaps in the current Observatory **FTE profile**; additional information must be gathered from ALMA and CDL to assure a complete FTE staffing profile over time can be compiled. Critical skills will be captured and categorized as part of that process.



Provided by: F. Giles/J. Firmani

Turnover rates dropped for both New Mexico (Socorro and VLA) and Green Bank sites during the past quarter, bringing the annualized attrition in-line with the NRAO-wide rates. Charlottesville turnover increased over the same period with the departure of two employees per month from October through December. The reasons for their departures were not alarming in nature and varied from moving out of state to ending appointments.

Observatory Management Services

- ***Fiscal Division***
  - Assisted with the design and implementation of the Other Direct Cost (ODC) allocation pool
  - Implementation for employees in Socorro and the VLBA sites of ACH payments for employee travel reimbursements
  - Started research on implementation requirements for accounting software to process ACH payments
  - Re-design of the "Fringe Pool" to increase the efficiency of the allocation of fringe benefits has slipped from Q1 to Q3
  - OMB A-133 audit continued on track for an expected Q2 closure

Provided by: C. Williams/G. Clark

Assisted with the design and implementation of the **Other Direct Cost (ODC)** allocation pool. These activities will continue through the year.

Implementation for employees in Socorro and the VLBA sites of ACH payments for employee travel reimbursements has commenced in Q1 per the plan. Currently reviewing the efficiency of issuing EFT transfers from one bank rather than two. The milestone for completion to research and initiate implementation of **ACH payments** to vendors for all categories of payments is Q4. However, this quarter, we have begun the process of drafting and researching implementation including the requirements of our accounting software to process ACH payments rather than checks.

The milestone pertaining to the **re-design of the "Fringe Pool"** to increase the efficiency of the allocation of fringe benefits has been revised from Q1 to Q3. Effort to redesign the fringe pool was delayed by other, higher priority projects such as the implementation of ETK and the A-133 audit. AUI implemented a new audit schedule this year which incorporated interim fieldwork that began in August, 2009 three months earlier than the prior year. Since the redesign is to increase efficiency given that we currently have a fringe pool allocation process- the project was deemed as secondary to the above. There is no impact on current fiscal processes other than efficiency –for the delay.

Cost benefit analysis of implementing an electronic documents management and archiving process is schedule to conclude end of this fiscal year. In Q1, we have begun the process of interviewing a local company that has implemented electronic documents management. The next step is to select a company and provide a cost/benefit analysis.

The **OMB A-133** will be completed on February 4, 2010- the audit spanned from August 2009 thru February 4, 2020. However preparation for the audit began in June 2009. Completion of the FY 09 IRS Form 990 is scheduled for Q2. Currently, the Form 990 is being completed and the scheduled delivery date is May 15, 2010.

Observatory Management Services

- ***Management Information Services (MIS)***
  - Modified financial reports
  - Continue the stabilization and enhanced data mining for ETK
  - Establish the MIS business systems as the central repository for employee information
  - Continue planning of major J.D.Edwards ERP upgrade
  - Investigation of AUI Recommended Cost Pools
  - AUI IT Risk Assessment
  - NSF DCAA Audit (Internal Controls, Incurred Cost, Program Planning)

Provided by: C. Beverage/G. Clark

Management Information Services (MIS) focused on the consolidation, review, and rewrite of most **financial reports** this quarter. Continued the stabilization and enhanced data mining for the NRAO **Electronic TimeKeeping (ETK)** systems. Initiated a move to establish the MIS business systems as the central repository for employee information with exports to the NRAO phone directory and business services. Continue planning of major **J.D.Edwards ERP upgrade** from the current 8.10 version to the newest version of EnterpriseOne. Engaged in three unplanned activities: investigation of **AUI Recommended Cost Pools**, **AUI IT Risk Assessment**, **NSF DCAA Audit** (Internal Controls, Incurred Cost, Program Planning).

Observatory Management Services

- ***Contracts and Procurement***
  - Prep work began in support of Observatory-wide contractor procurement system review (CPSR) by the external auditors
  - Increasing efforts to commit ARRA Funds

Provided by: P. Donahue/T. Miller

In the Contracts and Procurement area in Q1, completed CPSR field work and the first draft of the management Response to Report in preparation for the Observatory-wide contractor procurement system review (CPSR) by the external auditors scheduled for Q2.

There is 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. There is a risk that the website will not be updated as planned. The current mitigation is to identify resources (C&P, MIS, AUI and Legal) to update the website and set time aside to revise and acquire approval for forms, terms and conditions and certifications.

Contracts and Procurement is currently shifting resources and workload to place a high priority on ARRA projects. In addition, C&P increased the Green Bank Buyer from .5 FTE to nearly full time and authorizing overtime.

Observatory Management Services

- ***Environmental Safety and Security***
  - ***Charlottesville***
    - Edgemont
      - Cameras were installed to focus on the parking lots and interior spaces where surveillance gaps existed
      - Replaced HVAC system
      - Calendar Year 2009 security audits completed; minor findings corrected
      - Fire extinguisher inspections completed – no defects found

Provided by: R. Daniels/G. Clark

Edgemont Road Facility: Planned **cameras** were installed. Considering whether additional cameras are required for HR, IT, etc. Replacement of the Heating, Ventilation, and Air Conditioning (**HVAC)** system (February 2010). Conducted Security Audits (after hours) at Edgemont Road. Only minor defects located on window security. Exterior door handles were removed from Auditorium escape exits to improve protection from break-in. The 2008 Safety Inspection of the ALMA project found numerous defects and left several recommendations. NRAO committed with the other executives to revisit the recommendation status in approximately one year. This was done in 1Q10. The majority of the recommendations had been addressed. Metrics to monitor improvement were in place and we are monitoring monthly via the JAO Safety Report. **Fire Extinguisher Inspections** completed. Fire main maintenance completed in Stone Hall. Review of 2008 NSF safety inspection (OSF) accomplished **–** report submitted to JAO & NRAO Alma Project Manager. No defects were found by the UVA Fire Department. Evaluating if existing electronic card access system should be expanded to provide proximity pad access control to the communications room, Computer and Information Systems office and server room area, and the Human Resources/Business Services areas. A cell phone booster and PA system using the existing phone system was planned for FY2010, however the status is in jeopardy for high cost. Also reevaluating the need/options based on some recent improvements in local service coverage.

Observatory Management Services

- ***Environmental Safety and Security***
  - ***NTC***
    - Security Audits completed; minor findings corrected
    - Fire extinguisher inspections completed – 8 replaced out of GB
  - ***New Mexico***
    - Annual Safety Inspection completed; no defects found
    - VLA Tech Services evacuation drill has been conducted
    - Fire Extinguishers update program initiated
    - Regulatory training requirements met
    - Eliminated the storage of ALMA related chemical waste at the EVLA

Provided by: R. Daniels/G. Clark

NRAO Technology Center Facility (NTC): Conducted **Security Audits** with minor findings noted in window locks, master key for office checks needed, and addition of lighting to the rear parking lot needed. A plan will be put in place to address. Site safety committee meeting was held on November 17th. **Fire Extinguisher Inspections** were completed – 8 extinguishers that were at the end of the useful life, were replaced from GB stocks of used but rebuilt extinguishers rather than buying new ones as those at NTC were of the "throw away" type and could not be re-used. Conducted OSHA type inspection of NTC FEIC. Results were good. Some electrical defects that have been corrected. Additional mechanical defect in loading dock platform has been repaired. An Escape Ladder Structure installation, which will provide an approved alternative emergency egress method, is to be scheduled when the weather warms.

New Mexico Facilities: Annual Safety Inspection was completed with no defects found. Monthly VLA Site Safety Meetings all conducted. Annual inspection of the VLA site automated external defibrillators completed. EPA monthly generator logs completed**.** NRAO Drug and Alcohol testing for CDL drivers completed. Annual DOT Drug and Alcohol report completed and filed. Antenna safe work inspections ongoing. As part of the FY2010 commitment to conduct one drill at each of our major facilities, a VLA **Tech Services Evacuation drill** was conducted in this quarter. Began VLA site **Fire Extinguisher update** program – 20 CO2 extinguishers rotated into VLA. Completion of all 28 Antennas planned by 2Q10. **Regulatory Training** was conducted for Respirator, Hazcom, Asbestos Awareness, etc. The NRAO has instituted a Green Program which focuses on improving recycle/reuse at all sites of batteries, scrap wood, cardboard, office paper, cans & bottles, metal and used oil. As part of this program, approximately 200 pounds of **ALMA-related batteries** stored at the VLA site were disposed of in environmentally safe manner.

Observatory Management Services

- ***Environmental Safety and Security***
  - ***VLBA Sites***
    - Hancock & Owens Valley site security improvements completed
    - Began security improvements on St. Croix, North Liberty, Brewster, Pie Town
  - ***Green Bank***
    - Regulatory training requirements met
    - Update fire extinguisher systems

Provided by: R. Daniels/G. Clark

VLBA Facilities: NRAO is currently upgrading its VLBA sites which have been assessed as "vulnerable". Six sites are being enhanced: Hancock & Owens Valley site security improvements completed (intermittent patrols, installed video cameras, etc. to tighten security); St. Croix, North Liberty, Brewster, Pie Town are in process. The remaining sites (Mauna Kea, Fort Davis, Los Alamos, Kitt Peak), are secured by location.

Green Bank Facility: Regulatory training requirements met, Hazcom, asbestos awareness, bloodborn pathogens, etc. Sewer treatment system continues in compliance since January 2007 (monthly testing). Changed out/updated over 100 **fire extinguishers.**

Observatory Management Services

- *Grants*

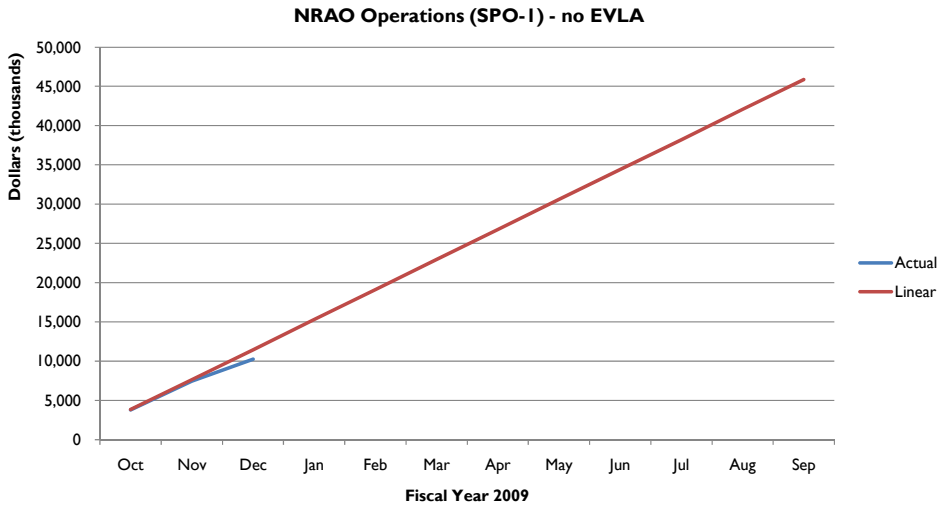
Name of Grant	Funding Institution	Grant Value		PI
What Drives the Conversion of Gas to Stars in Galaxies	STSCI	$103,412		Carol Lonsdale
RadioNet FP7 - ALBIUS	European Commission	$15,538	*	Brian Glendenning
RadioNet FP7 - VLBA	European Commission	$107,071	*	Jim Ulvestad

* - Initial award, subject to additional funding

Provided by: T. Miller/G. Clark

This is a new section referencing new grants obtained during this quarter.

Observatory Management Services Financial Performance



NRAO

Provided by: T. Miller/G. Clark

NRAO Operations (less EVLA) FY 2010 new funding allocation is $43,149k. Total available funding including prior year commitments and carryover totals $48,884k. Expected total spending for FY 2010 is $45,884k with $3,000k remaining to cover anticipated FY 2011 and FY 2012 funding shortfalls.

As of the end of the first quarter total expenses plus commitments total $10,227.9k (20.1% of allocation). Elapsed work days is 24.4% and total expenses plus commitments is 20.1%.