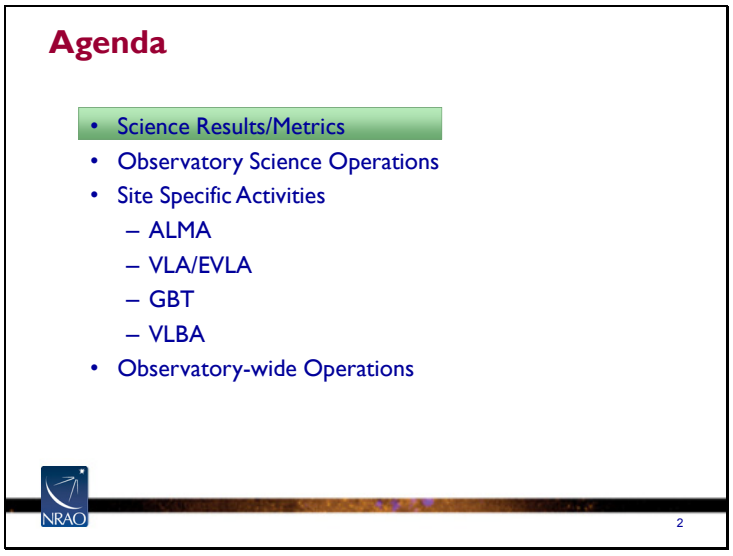
Slide 1

Quarterly Status Update (QSU) April-June FY2009

September 1, 2009

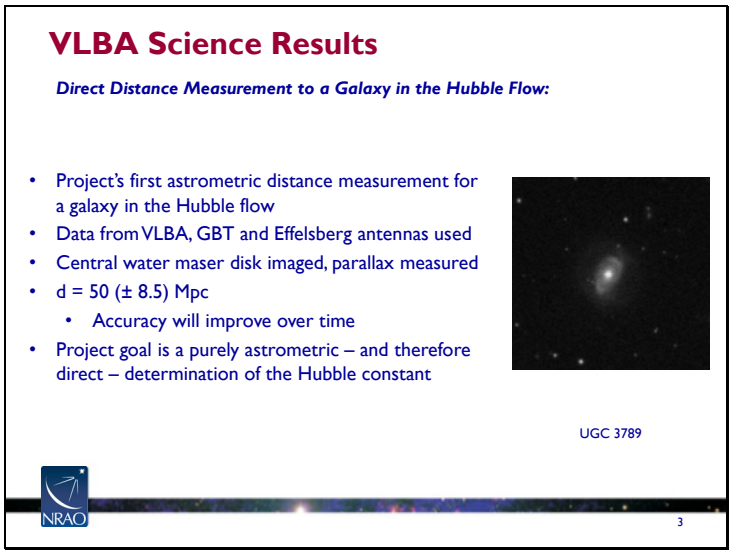
Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Long Baseline Array

Slide 2



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.

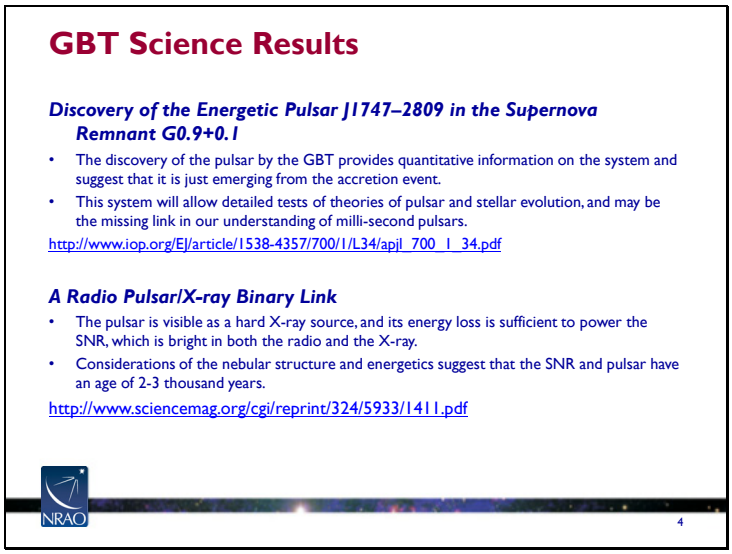
Slide 3



Direct Distance Measurement to a Galaxy in the Hubble Flow : The NRAO's Megamaser Cosmology Project, utilizing the VLBA, the GBT, and the Effelsberg telescope, has produced the first direct, geometric distance measurement to a galaxy within the Hubble Flow. This is an important stepping stone toward improving the accuracy of the Hubble Constant to a level sufficient to constrain models of Dark Energy. Multi-year observations of the maser disk in the core of UGC 3789 yielded a geometric distance of 50 Mpc, currently accurate to within 17 percent. Further work will improve the accuracy of this measurement. UGC 3789 is seven times more distant than NGC 4258, the first galaxy whose distance was measured by the maser technique with the VLBA in 1999. Publication not yet released.

Investigators: J Braatz (NRAO); M. Reid (CfA); C. Kuo (UVa), K.Y. Lo (NRAO); C. Henkel (MPIfR); I. Zaw (NYU); and A. Tilak (CfA).

Slide 4



Discovery of the Energetic Pulsar J1747–2809 in the Supernova Remnant G0.9+0.1: A pulsar recently discovered with the GBT seems to be the first example of this process observed at the important transition between accretion and emergence of the pulsar. The star that is the pulsar's companion was observed to flicker rapidly and have optical behavior typical of an accretion flow. However, since 2002 the star has been in a quiescent state. The discovery of the pulsar by the GBT provides quantitative information on the system and suggest that it is just emerging from the accretion event. Even now, some gas from the star occults the pulsar, giving further evidence that material is still being stripped from the companion star, though at a lower rate than before. This system will allow detailed tests of theories of pulsar and stellar evolution, and may be the missing link in our understanding of milli-second pulsars. http://www.iop.org/EJ/article/1538-4357/700/1/L34/apjl_700_1_34.pdf

Investigators: *Camilo (Columbia Astrophysics Laboratory), S. M. Ransom (NRAO), B. M. Gaensler (Sydney Institute for Astronomy), D. R. Lorimer (West Virginia University, Morgantown)*

A Radio Pulsar/X-ray Binary Link: Every century several supernova occur in the Milky Way, and one of their products should be young neutron stars. Some fraction of these ought to be visible as radio pulsars, and we expect that there is a total population of several hundred young radio pulsars in the Galaxy. To date, however, only a dozen pulsars with a characteristic age less than 10,000 years have been found, and fewer than 20 pulsars have a firmly-established connection with a supernova remnant (SNR). The recent discovery using the GBT of a pulsar at the center of a SNR is therefore of particular interest, especially as the pulsar has the second-largest known spin-down luminosity (second only to the Crab pulsar) and the SNR is less than one degree from the Galactic Center. The pulsar is visible as a hard X-ray source, and its energy loss is sufficient to power the SNR, which is bright in both the radio and the X-ray. The pulses are highly dispersed, consistent with a location of the SNR at the Galactic center or somewhat beyond. Considerations of the nebular structure and energetics suggest that the SNR and pulsar have an age of 2-3 thousand years. http://www.sciencemag.org/cgi/reprint/324/5933/1411.pdf

Investigators: *A. M. Archibald (McGill University), I. H. Stairs (University of British Columbia; Australia Telescope National Facility), S. M Ransom (NRAO), V. M. Kaspi (McGill University), V. I. Kondratiev, D. R. Lorimer, M. A. McLaughlin, J. Boyles, (West Virginia University; NRAO), (West Virginia University; NRAO), J. W. Hessels, J. van Leeuwen (Netherlands Institute for Radio Astronomy; Astronomical Institute Anton Pannekoek), R. Rynch (University of Virginia), M. S. Roberts (Eureka Scientific), F. Jenet (University of Texas, Brownsville), D. J. Champion (ATNF; CSIRO), R. Rosen (NRAO), B. Barlow, B. Dunlap (University of North Carolina, Chapel Hill), R. Remillard (Massachusetts Institute of Technology)*

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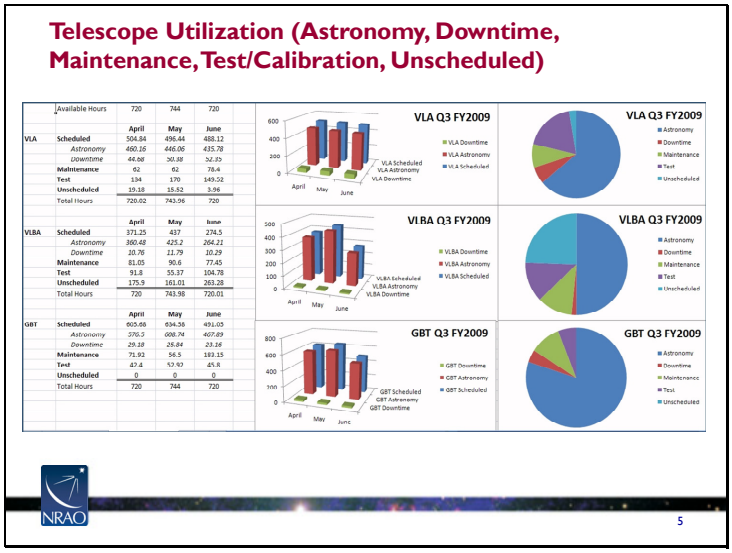

Scheduled = planned observing time.

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.

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

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

- The GBT has the highest numbers of scheduled observing hours
- Planned observing versus downtime (in percent): VLBA 97%, GBT 95%, VLA 90%
- Each of the telescope/arrays works with the same total number of hours, however, the actual observing, as a percentage of the overall activities (maintenance, test, unscheduled) is: GBT 75.7%; VLA 61.4%; VLBA 48.1%.

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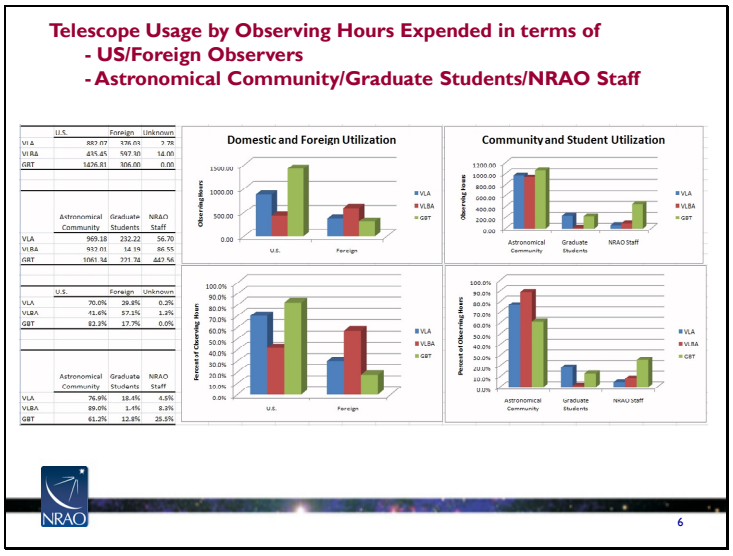

All metrics are compiled by project team, not principle investigator. For example, if a project team consists of 5 people, and they observed for 100 hours, and 2 people were from Virginia, one was from California, and 2 were from Massachusetts, then we would report 40 hrs Virginia, 20 hrs California, 40 hrs Massachusetts.

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

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

- GBT has the highest percent of US observers
- Highest percentage of non-US observers is at the VLBA (58%), then the VLA (30%), then GBT (18%)
- Of Astronomical Community observations (versus graduate students and NRAO staff), the strongest Astronomical Community use is with the VLBA (90%); VLA (77%); GBT (62%)

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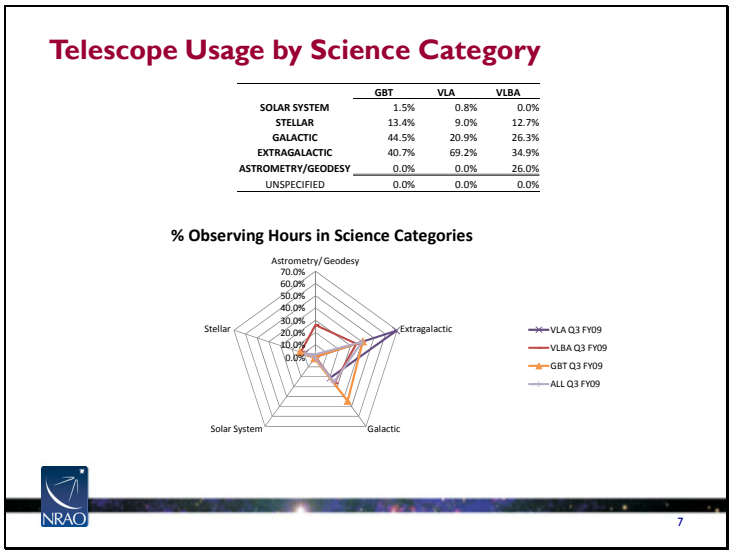

Basic analysis (some trending may be due to seasonal variations in activities; full year trending analysis will be performed at the culmination of the fiscal year):

- The NRAO primarily engages in galactic, or extragalactic research.
- VLA focus is predominantly in the extragalactic area, whereas the GBT is very close between galactic and extragalactic. Of the NRAO telescopes/arrays, the GBT does the primary solar system and stellar research, with the VLBA following.
- The telescopes are used more heavily in different types of science: GBT-galactic; the VLA-extragalactic, the VLBA extragalactic, but also in a unique area of astrometry/geodesy. The GBT and the VLA are also engaged in solar system research.

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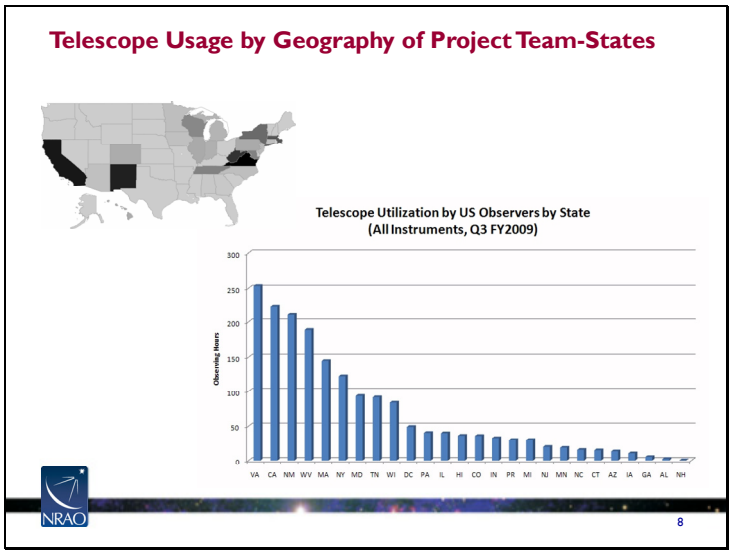

Basic analysis (some trending may be due to seasonal variations in activities; full year trending analysis will be performed at the culmination of the fiscal year):

- **Observing hours** (not by project) are used by investigators (PI) tied to US institutions, which provides the locations.
- Three of the top four are where the NRAO has facilities.

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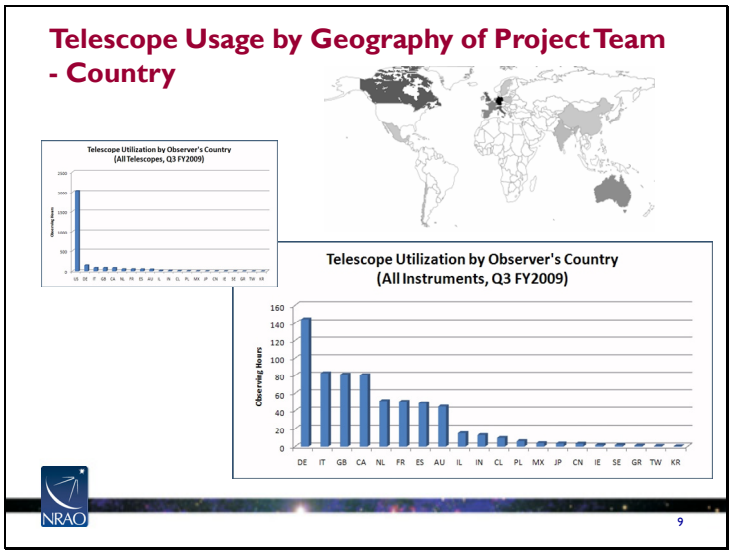

Basic analysis (some trending may be due to seasonal variations in activities; full year trending analysis will be performed at the culmination of the fiscal year):

Observing hours (not by project) are used by investigators (PI) tied to non-US institutions, which provides the locations.
Well represented in Germany, Italy, UK, and Canada.

AU = Australia	IL = Israel
CA = Canada	IN = India
CL = Chile	**IT = Italy**
CN = China	JP = Japan
DE = Germany	KR = Korea
ES =Spain	MX =Mexico
FR = France NL = Netherlands	
GB = UK	PL = Poland
GR = Greece	SE = Sweden
IE = Ireland	TW = Taiwan

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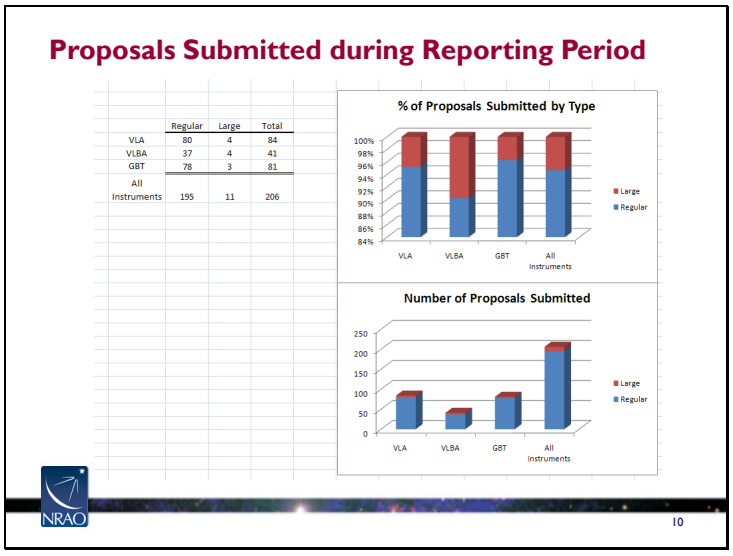

Basic analysis (some trending may be due to seasonal variations in activities; full year trending analysis will be performed at the culmination of the fiscal year):

- The VLA and GBT had the most proposals (almost equally) submitted during this period.

At the June 1, 2009 proposal deadline, scientists submitted 84 VLA proposals, 41 VLBA proposals, and 81 GBT proposals for a total of **206 submissions**. A total of **11 proposals were large projects,** requesting 200 or more hours of telescope time.

Of these 11 large project proposals, **2 requested support for student research**. An **additional 11 regular proposals also noted student** involvement.

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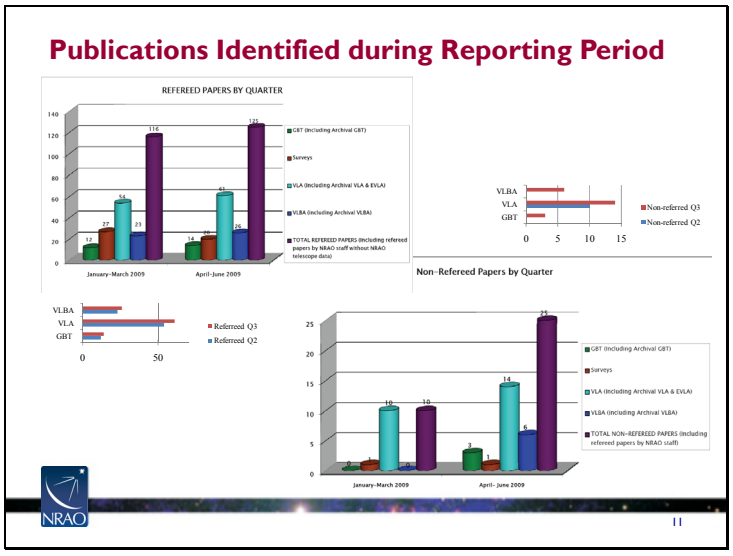

Refereed show fairly steady growth; seems to be more steady.
Non-refereed number grows as you get further along in the year.

- While in comparison to utilization rates for the telescopes, much of the VLA publications come from usage of archival data. Since the VLA has been around for so long, there is more archival data to publish from.
- On average it takes 5+years from observation to publication.

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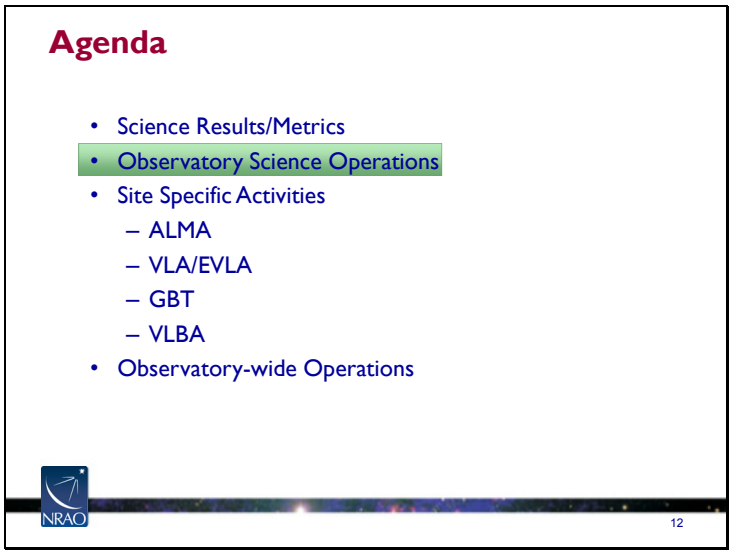
Agenda
• Science Results/Metrics
• Observatory Science Operations
• Site Specific Activities
– ALMA
– VLA/EVLA
– GBT
– VLBA
• Observatory-wide Operations
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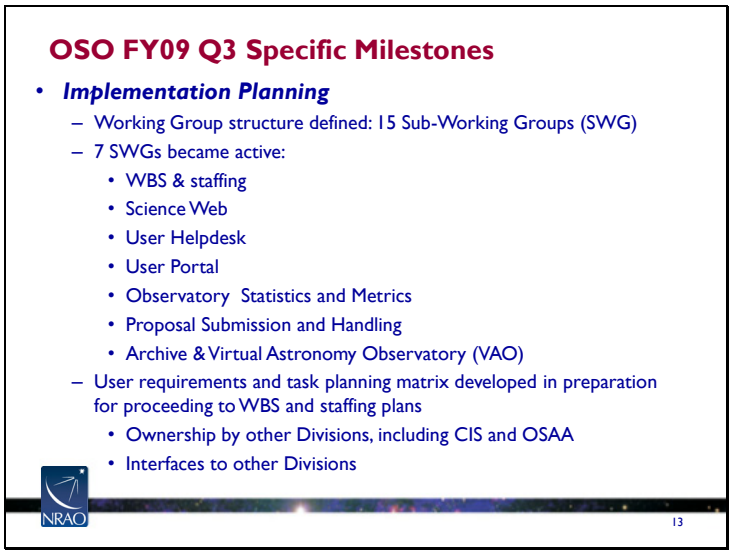

The Observatory Science Operations Working Group is charged with defining the scope of the new Division and delivering an implementation plan by April 2010. Some elements are proceeding directly to implementation because they have already been operating, in whole or in part, in an observatory-wide fashion. **15 Sub-Working Groups (SWG)** have been defined: Organization: WBS & Staffing; Science Web (owned by Communications); Science User Outreach; User Training; User helpdesk; User portal ; Proposal Process; Observation Preparation; Observatory Metrics and Statistics; Offline Data Processing (software); Pipelines, Algorithm R&D; Computing; Archive and Virtual Astronomy Observatory . **7 SWGs are currently active,** to avoid too much work effort in parallel.

Overall implementation planning is undertaken by the **WBS & Staffing SWG**. A **detailed mapping of user requirements** to support activities at NRAO, both day-to-day operations support and development activities, has been developed. Identification of **ownership** of, and **interfaces** to, these activities by **other Divisions** of has begun.

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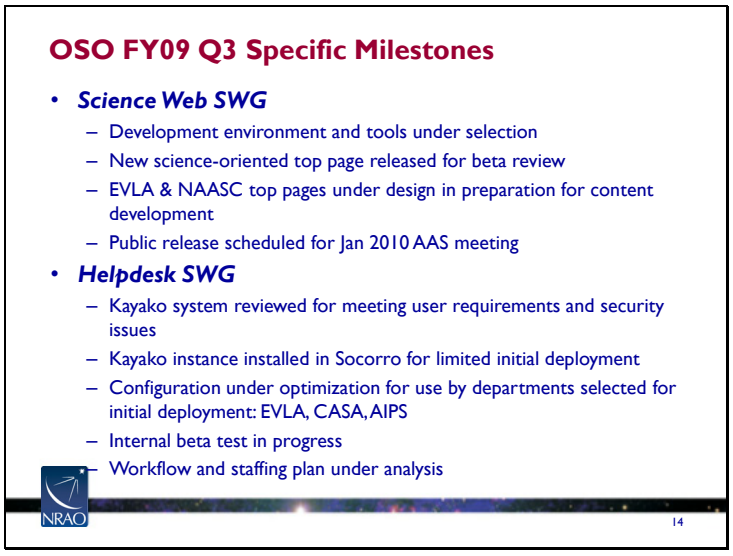

The **Science Web SWG** is completing evaluation of the **development environment**. A new entry point **top page** for the science community has been protoyped and released for **internal beta review**. New **top pages for EVLA and ALMA**, to be reached directly from the science web top page, have been designed to be parallel in look & feel to each other, and in content. **Content development** can now begin for these. Parallel pages for GBT & VLBA can then follow.

The **Kayako helpdesk system** was **evaluated and installed** for **beta testing** in Socorro. The **configuration is under optimization** for use by observing with the **EVLA,** and data processing using Common Astronomy Software Applications **(CASA) and** Astronomical Image Processing System **(AIPS).** These 3 departments were selected for **initial deployment** due to having the shortest critical path, in support of EVLA proposal process beginning in September 2009.

A **workflow and staffing plan** is under analysis.

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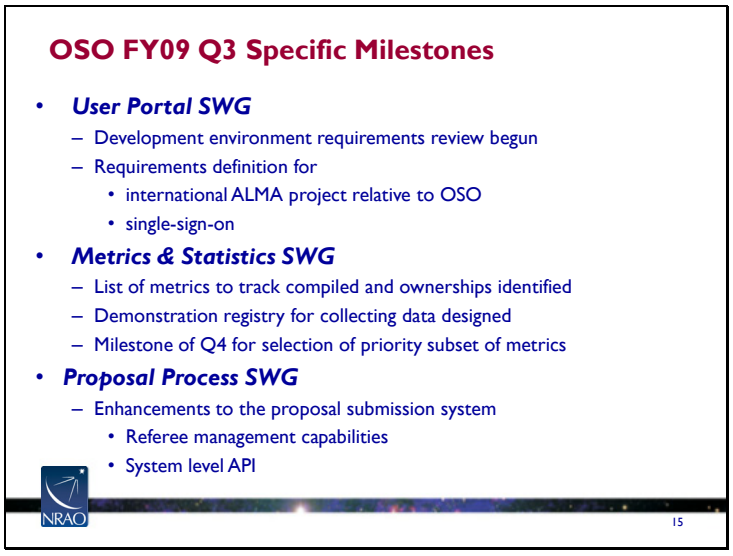

The **User Portal SWG** has begun discussion of the optimum **development environment** choices. The international ALMA project has committed to PLONE for its development environment (for the ALMA archive and other tools), therefore OSO is **reviewing NRAO's options,** given this situation. It has been decided that **single-sign-on** is a requirement, *ie.* a user need sign-on only once per session to access all NRAO's password-protected user services.

The **Metrics and Statistics SWG** has **compiled a list** of possible statistics that NRAO could track The **registry** that will be used to collect the data has been designed, as a demonstration for review by mid-July. A milestone has been set of Q4 for the selection of the **set of priority metrics** that will be used to initiate the new reporting system, and the **personnel responsible** for the collection of each of them identified.

In preparation for the proposal submission period, there were several enhancements made to the proposal submission system, including the addition of **referee management capabilities** and the development of a system-level **Application Programming Interface** (API) to enable other NRAO software systems to communicate with the proposal system. Planned development for Q3 includes the addition of EVLA OSRO I and OSRO II to the types of observing that can be requested.

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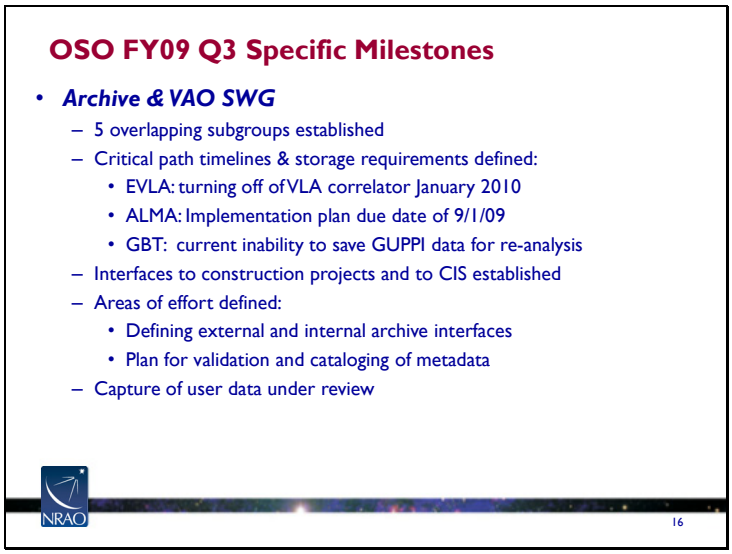

The **Archive and VAO SWG** initial focus has been on defining the **critical path timelines and storage volume** for science data product archive from each of the key instruments (EVLA, ALMA and GBT) for the 5-year horizon to allow budget and staffing guidance to be established. The archive driver for **EVLA is turning off the VLA correlator** in January 2010 with new data flowing into the NGAS archive in Socorro. A driver for the **ALMA** archive is an **implementation plan for presentation to JAO by September 1st**, while the **GBT has the immediate concern that GUPPI data is being discarded** after the initial analysis, thereby precluding future re-processing.

To help focus and distribute the effort, the Archive & VAO Working Group has been divided into **five overlapping sub-groups** (three instruments, VAO, and Archive Strategy) with an "accountable" owner identified for each, together with key support contributors responsible for executing to plan. It is important to note that many of the deliverables and milestones to be tracked in this working group are **owned by the construction projects**, with the WG foreseen as providing a forum to ensure coherence in approach. The key area for effort is defining the **external and internal interface** to the Archive. External access should be enabled through the VAO, with Internal being defined by the pipeline generating the product from the instruments. In both cases the **validation and cataloging of observation metadata** is critical.

The question of **capturing user data** (generated during post-processing) has been raised, and will be handled by the Computing working group, but we need to address the issue of whether and how users can post valuable reduced data products back into the archive with appropriate attribution. A concern has been raised regarding the possibility that EVLA and ALMA will develop parallel ideas regarding archive development. A particular issue is the manner in which upper level user access will occur with the recommendation being that the working group **recommend a strategy to ESO and JAO** consistent with the needs of NRAO.

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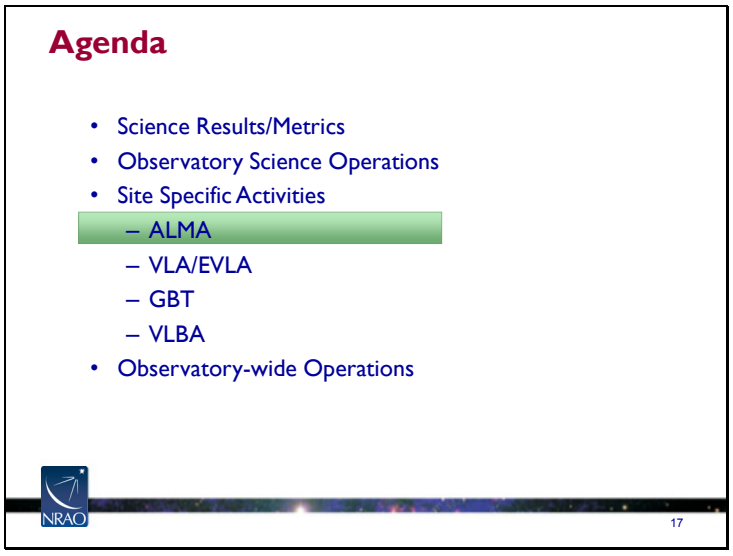
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Atacama Large Millimeter/ Submillimeter Array (ALMA)

- Content from a combination of sources
  - NRAO ALMA submissions sent directly to NSF versus JAO reports (per request of NSF)
  - NSF Monthly Reports to NSF
  - NRAO Business Services
  - North American ALMA Science Center

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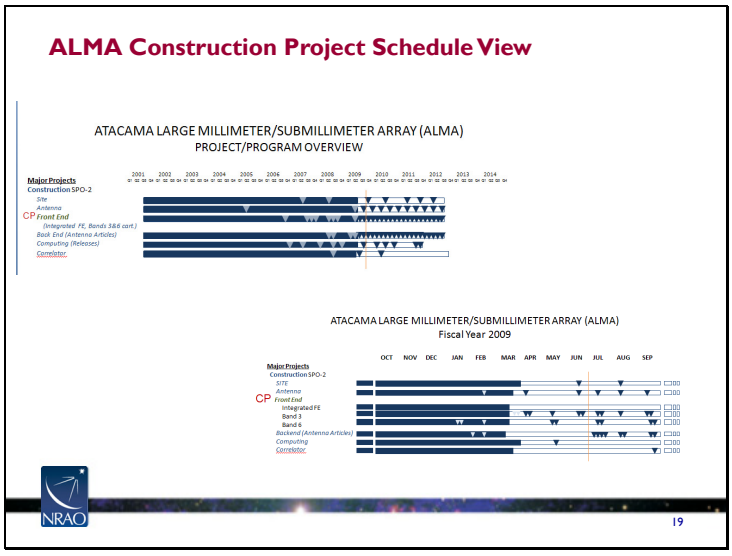

The first graph illustrates the full lifecycle. The second graph is this fiscal year view. The vertical line represents where we are today. The CP represents the critical path.

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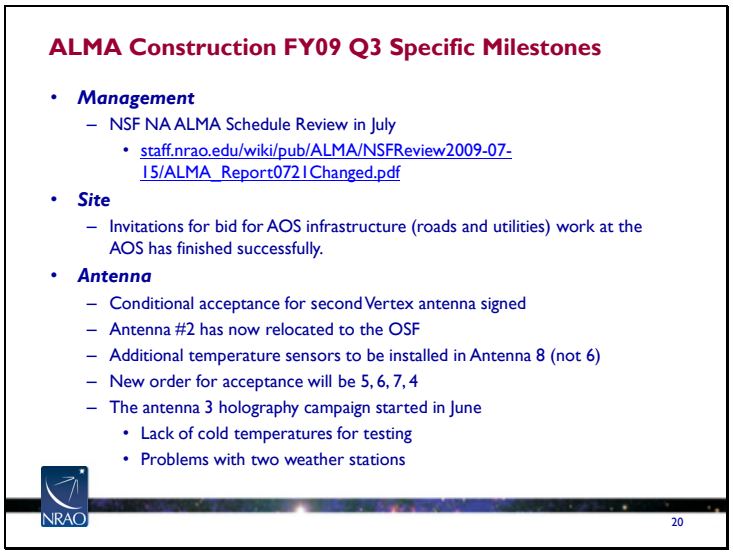

MANAGEMENT: Preparations for the upcoming NSF NA ALMA Schedule Review in July have dominated the work in this quarter. The review was chaired by Jim Yeck, the Project Manager of the Ice Cube project. The scope of this review was the prominent components of the US-funded receiver system - specifically the Band 6 receivers, other front-end components, the NA front-end integration center, back-end photonic system - and the Vertex antennas. By agreement with the Herzberg Institute of Astrophysics (HIA) of the National Research Council of Canada, information regarding the Band 3 receivers being provided by HIA was also be included in this schedule review. The charge was to review the schedule of NA deliverables and examine the NA contingency given the schedule, budget, risks and forecast liens on contingency. The final review document is available at: staff.nrao.edu/wiki/pub/ALMA/NSFReview2009-07-15/ALMA_Report0721Changed.pdf .

SITE: Grading of the central cluster has been completed. **The bidding process for the procurement of FO cables has concluded** and is awaiting approval. The AOS Roads construction contract was awarded and the kick-off meeting with the contractor is scheduled for early July. The AOS utilities (installation of FO and electrical cables) bidding process concluded and is awaiting approval. The complete AOS roads and utilities work is expected to require a total contingency release of ~$10M, from a budget of 27.7 M$ to and estimated total for completion of ~38 M$.

ANTENNA: On April 29 the **second Vertex antenna was conditionally accepted** and **has been relocated to the OSF**. The main conditional acceptance clauses are completion of the maintenance verification, offset pointing & tracking, and to take more data on the surface to allow a better extrapolation of the data to the most extreme cold temperatures that antenna will face. Following discussions with Vertex it has been agreed that antenna 8, not 6, will be outfitted with the additional temperature sensors desired for further investigations of the

surface accuracy vs. temperature. Antenna 8 will not be ready for holography measurements until September. As a result of this and in order to keep forward progress, it has been decided that a full campaign of holography measurements would be done on antenna 3, even though antenna 3 does not have additional temperature sensors. With antenna 4 reserved for maintenance verification activities, the next antenna to be conditionally accepted (the third one) will be antenna 5. The new order for acceptance will be 5, 6, 7, 4.

The antenna 3 holography campaign started in June. The first task was to set the surface of the antenna to a reasonable value and this was achieved remarkably easily and the surface was set to ~13.5 microns in what was effectively a single adjustment. Since the surface vs. temperature investigations are looking for changes in the surface, 13.5 microns is more than adequate. Over a two week period over 50 good holography maps were acquired. The main problem has been that there have been **no really cold nights**. The coldest temperatures have rarely reached about 4 °C, with several nights where the temperatures did not get below 8 °C. There have also been **problems with the two weather stations**. A new portable (data logging) weather station has now been procured. Analysis of the data is underway, but the initial results look both reproducible and encouraging. Preparations are almost complete for the start of the Phase 4 maintenance testing on antenna 4.

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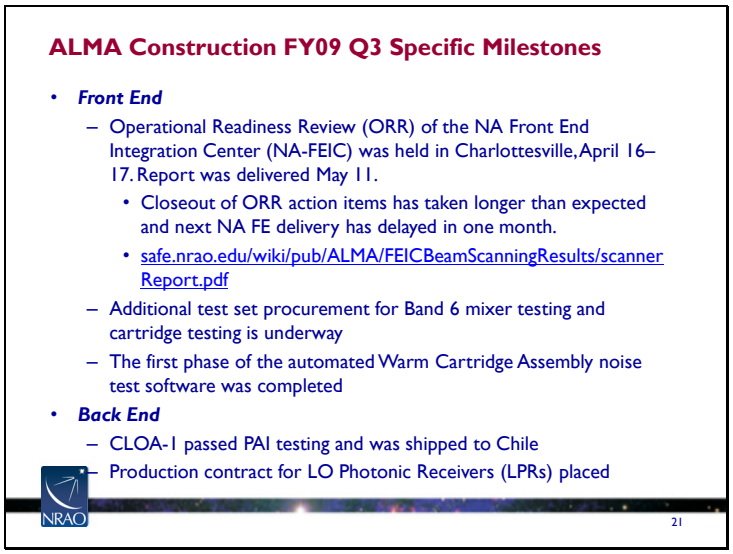

Front End: The **Operational Readiness Review (ORR) for the NA Front End Integration Center (FEIC) was held on April 16–17** in Charlottesville. Jacob Kooi (Caltech) chaired and a draft version of the review panel report was delivered on April 24. The full version of the panel report is was delivered May 11. The report included 11 action items that need to be closed. Work is ongoing to close these action items, but it is taking longer than estimated with a consequential one month delay in the delivery of the next Front End (FE) from the NA-FEIC. The Project Management Control System (PMCS) team and the Regional Project Managers and IPTs are working to resolve issues related to the shortage of subassemblies/components to be delivered to FEICs. Their status is continuously monitored and corrective actions are requested. The report can be obtained at: safe.nrao.edu/wiki/pub/ALMA/FEICBeamScanningResults/scannerReport.pdf .

In reviewing the **Band 6 schedule**, the procurement of an additional test set will allow Band 6 to increase its throughput to meet the target of completing all cold cartridges by the end of 2011. However, the cross polarization performance of the cartridges still does not meet the specification. Investigation of this continues. In the interim it has been agreed until July to continue to accept cartridges with a waiver on the cross polarization requirement and to plan to retrofit once the issue is understood. The **first phase of the automated Warm Cartridge Assembly** noise test software was completed. This reduces the test time for one key test from four hours to forty minutes and will relieve a great deal of pressure on the test facilities.

Back End: **Central LO Article (CLOA) 1** PAI testing passed its Preliminary Acceptance In-house (PAI) tests and was shipped to Chile. The system meets or exceeds all the specifications (phase drift, tuning range, switching speed, etc.), except phase noise, where it marginally misses at some frequencies. Delivery of CLOA1 is a major milestone for ALMA. It was also one the items for ACSV that required the most acceleration and that has been achieved. Once accepted and tested at the AOS in Chile, this will represent a significant risk reduction for ALMA. The production contract for LPRs (LO Photonic Receivers) was placed with Lightwave 20/20. Antenna Articles (AA) 3 & 4 have passed PAS in Chile and are working in the lab at the OSF. AA 5 was shipped to Chile in May along with six fiber optic wraps (enough for three antennas). AA 6 through AA 8 were shipped to Chile in June. This shipment included the analog and digital racks. With this shipment the transition to the use of "golden racks" for testing is complete. All subsequent shipments will consist solely of BE modules and cables. These will meet the Chile-assembled racks at the OSF during PAS for each AA. LO photonic receiver (LPR) SN 103 has been delivered to the EU FEIC for outfitting into EU-FE #2.

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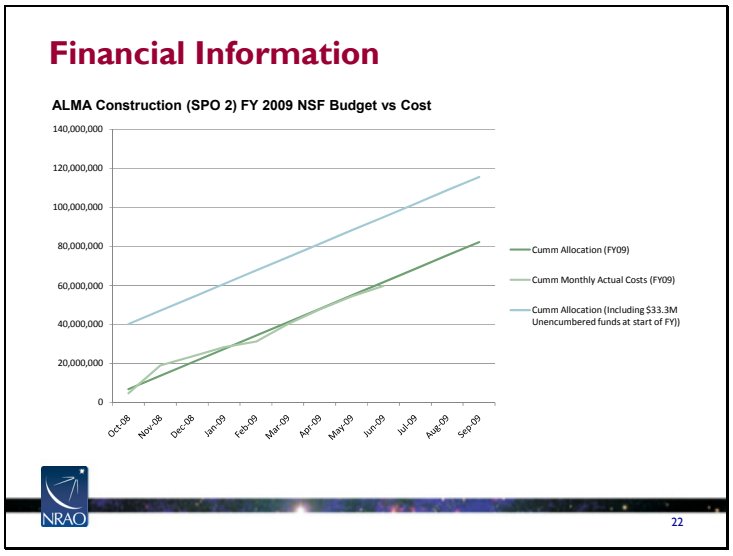

For ALMA Construction, the June data is estimated as Fiscal had not closed at the time this was made. The data for October 2008 has taken into account the effect of the releasing of the accruals to show the real expenses (i.e., checks written). In summary, these charts do not reflect the actual distribution of funds from NSF, nor do they reflect the internal spending plan, but they do provide a high level visualization.

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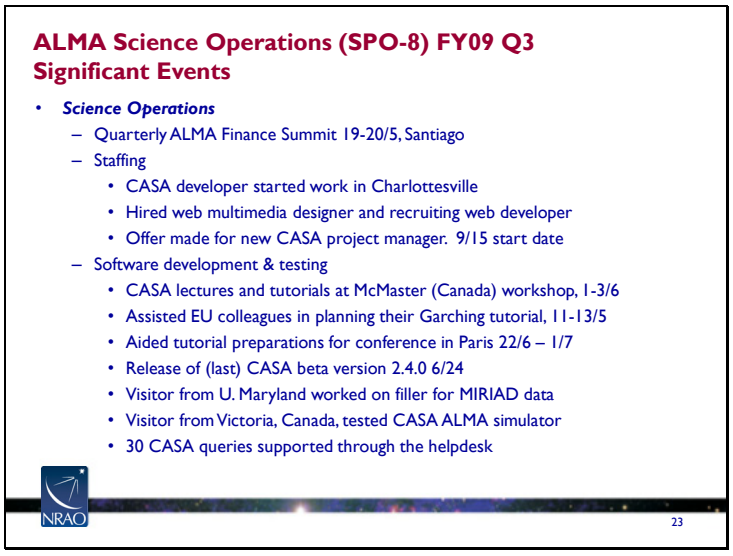

The position of **CASA project manager** was filled, and the new **CASA developer**, David Mehringer, joined the NAASC staff in Charlottesville. Recruiting for the **web media designer** concluded with an acceptance from Jeff Hellerman; interviews continue for the **web content developer**.

NAASC staff supported our Canadian colleagues at their June 1-3 workshop "Preparing for ALMA: from Science to Observations", held at McMaster University, Hamilton, Ontario. Contributions were made to the Primer booklet developed in preparation for the meeting, and **CASA lectures and tutorials** were given by NAASC staff. Help was provided to colleagues at the European ARC in designing and running their **CASA tutorial** in Garching, and with **CASA tutorials** at a Multiwavelength Blackhole conference in Paris June 22 - July 1.

Computing concluded its integration/test of the R6.1 software and of the CASA version 2.4 software. The R6.1 software was tested in Chile in June re-established dynamic fringes (with computer control of delays) for the first time (this had previously been routine at the ATF). The next release will be an open one to the community at the end of calendar 2009. The software for the production optical telescope was integrated into the high-level R6.1 software. On the sky tests in Chile are scheduled for July. The CASA pre-release was successfully used in two tutorials in Garching and NAOJ, with generally positive feedback. Some problems which were discovered will be corrected in the final release. Another tutorial was performed in Hamilton, Canada, in early June. An offer was informally made and accepted by a qualified candidate for the CASA Manager position.

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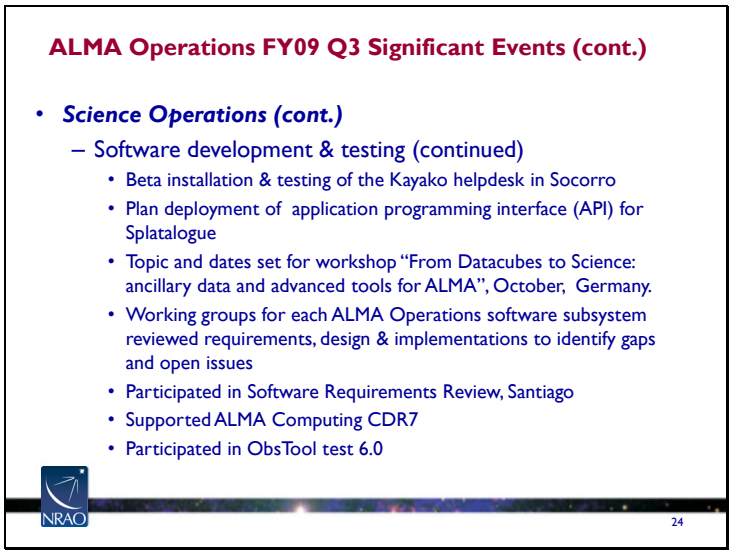


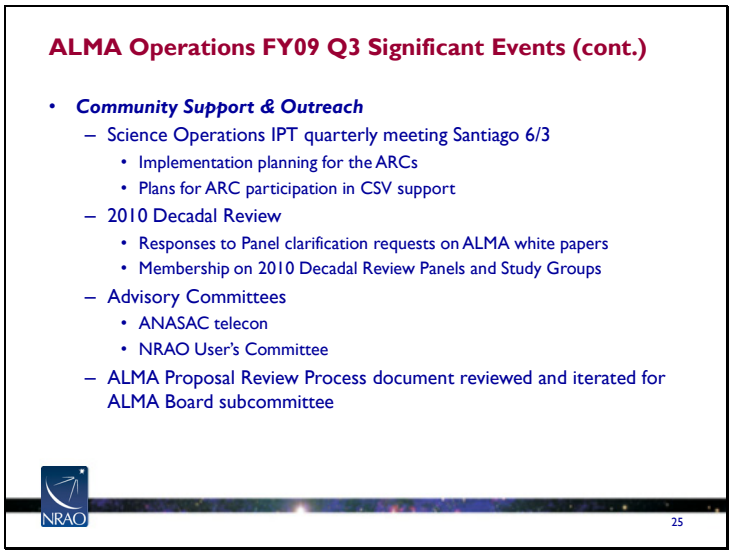
The **Kayako** helpdesk system was evaluated and installed for **beta testing** in Socorro. A workflow and staffing plan is under analysis. A second installation in Charlottesville is underway to test ALMA's needs for multiple helpdesk instances around the globe.

The spectral line **Splatalogue** software development continued with a visit from architect Alan Markwick from UMIST. An **API** is to be implemented. An **international workshop** was agreed on for joint development of advanced tools for spectral line analysis.

Working groups were formed for each software subsystem, including *Obsprep, ObOps I, ObOps II, Scheduler, Pipeline, UP/Helpdesk, Archive*, telecons were held to identify missing operations-specific requirements and unresolved open issues. The **Software Requirements Review** was held June 1-2 in Santiago. A new NAASC-chaired Focus Based Team was charged with defining **ALMA observing modes** and interfacing them to *ObsPrep*. Final spreadsheets & power point presentations provided as input to the **Computing CDR7**, held June 22-26 in Santiago.

ObsTool test 6.0 occurred. Two NAASC staff were able to prepare dummy proposals but the archive submission step failed. Other staff were unable to get the correct version of Java successfully installed o their Macs.

Slide 25



The quarterly face-to-face meeting of the **Science Operations Integrated Project Team** held in Santiago June 3 2009. The TOC and writing assignments for the **Science Operations Implementation Plan** were developed. The requirements for ARC participation in **CSV support** were developed.

Several staff members participated in the on-going **2010 Decade Review** process, answering questions about ALMA white papers and sitting on Panels and Study Groups.

Presentations were made to the **NRAO User's Committee**, and a telecon was held with the **ANASAC**, which is reviewing simulator performance, and considering the needs of the North American community with respect to the Proposal Review Process.

The ALMA Board is preparing a plan for the **ALMA Proposal Review Process**; this quarter NAASC developed a draft of this document incorporating all recent discussion across the project on the topic.

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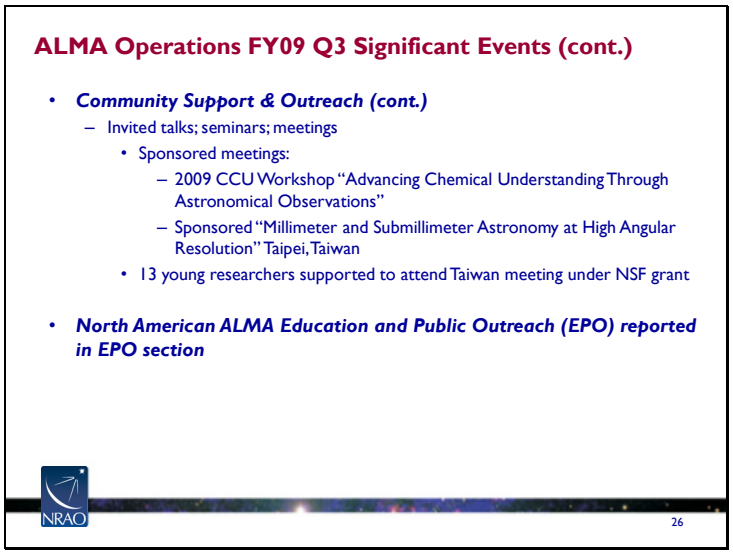

Outreach to the science community took the form of attendance at several conferences. In particular NAASC was a sponsor of the 2009 Center for Chemistry in the Universe Workshop: **"Advancing Chemical Understanding Through Astronomical Observations"**, and the Taipei meeting: **"Millimeter and Submillimeter Astronomy at High Angular Resolution"**. NAASC also successfully obtained grant funding to assist 13 young researchers attend the Taipei meeting to learn about mm interferometry. Invited talks were given by NAASC staff at the June **AAS meeting** in Pasadena; at **"20th International Symposium on Space Terahertz Technology"** and at **"Advancing Chemical Understanding Through Astronomical Observations".** The **4th NAASC workshop** opened for registration. The list of invited speakers and the poster were finalized.

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Office of Chilean Affairs (OCA) FY09 Q3 Significant Events

- Three new Expats for a total of 19 managed
- 38 new Local staff contracts signed
- Support for bids and/or contracts for a total of ~15 MUS$
- Renewal of mining rights over ~80% of ALMA Concession
- Participation in the Environmental analysis of ALMA Power supply
- Strong EPO presence in Chile in the IYA09

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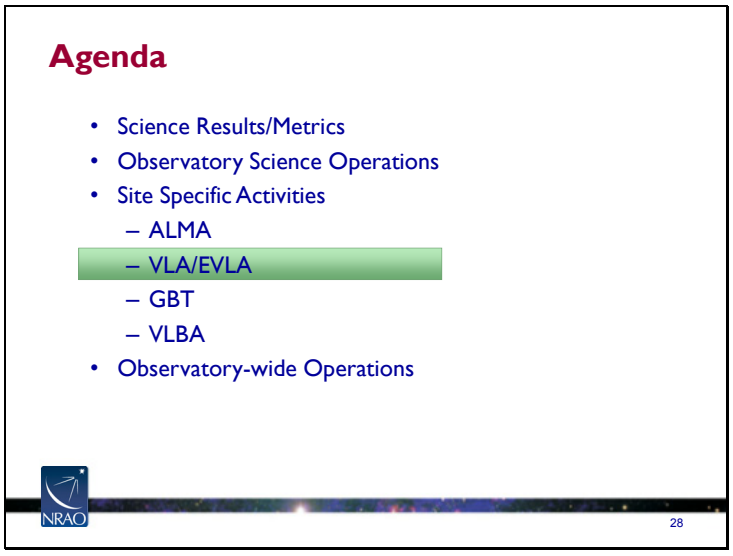
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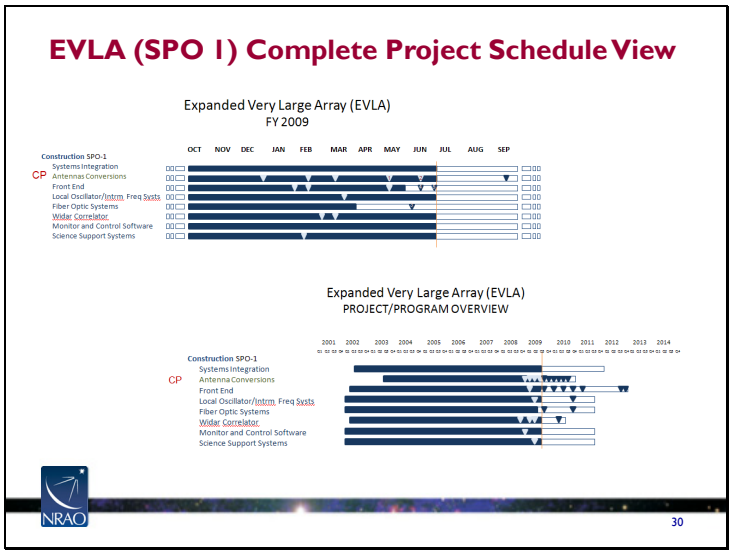
Very Large Array (VLA)/Expanded Very Large Array (EVLA)

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

Slide 30



Overall, the EVLA project remains on schedule. The conversion of antennas to the EVLA design is scheduled to be complete in Q3 CY2010. The installation of the WIDAR correlator is scheduled for completion in Q1 CY2010. The last EVLA receiver will be installed in late CY2012. The critical path to project completion currently runs through the conversion of the antennas to the EVLA design and will move to receiver production at the start of FY2011.

Major milestones for the project this quarter are denoted by the red numbers in the FY2009 schedule view above, and are discussed by number in the following slides.

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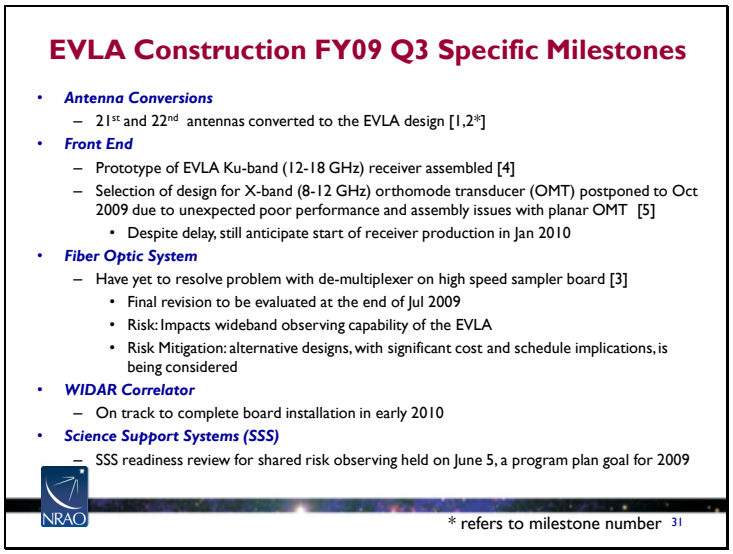

The **antenna conversion** schedule was interrupted by the failure of a pinion gear in an azimuth gearbox of EVLA antenna 5. The replacement of the gearbox and the azimuth bearing caused a one month schedule delay, but antenna conversions are still scheduled for completion in Q4 FY2010. Excellent progress continues with the production of feed horns for the EVLA. Nineteen S-band horns have been fabricated to date, which is well on track for the program plan goal of having 20 completed by the end of the fiscal year. The production of Ku-band (12-18 GHz) feed horns is underway at the Green Bank machine shop. The procurement of production quantities of the X-band (8-12 GHz) feed horns was initiated. A requisition was submitted for the horns' centrifugal castings, and bids are being solicited for the final machining of the castings. All other EVLA feed horns are complete.

The **Front End** Group is on track to meet its production goal of 49 receivers by the end of CY2009. The receiver production rate has doubled when compared to a year ago. Selection of design for X-band (8-12 GHz) orthomode transducer (OMT) *postponed to Oct 2009* due to unexpected poor performance and assembly issues with planar OMT. Despite delay, still anticipate start of receiver production in Jan 2010.

Fiber Optics has yet to resolve the problem with the de-multiplexer on the high speed sampler board. The risk in the impacts to wideband observing capability of the EVLA; the risk mitigation is in consideration of alternative designs.

The production order for the **WIDAR** baseline boards was placed in June, and 22 of the 128 station boards have been delivered to the EVLA. A test version of the WIDAR's configuration mapper software with a graphical user interface was released. The VLA correlator is scheduled to be replaced by WIDAR in January 2010.

The **Science Support Systems** (SSS) review committee found that SSS is well positioned to support EVLA shared risk observing (SRO) and did not believe that SSS posed a significant risk to the SRO schedule. The committee also found that the overall design of the SSS applications seemed sound, and the processes used to implement the software were generally good. The committee recommendations included devote more attention to refining the specific SSS requirements for SRO and define software acceptance processes (by non-SSS team members) within the EVLA project.

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VLA Operations FY09 Q3: Significant Events

- ***Engineering Services***
  - The VLA completed planned moves in May and June to:
    - CnB configuration (completed 5/22)
    - C configuration (completed 6/15)
- ***Computer Infrastructure***
  - Upgraded EVLA DSOC fiber connection to 1 Gbit s^{-1} (completed June 2009)
  - Upgrade AOC Internet connection to 1 Gbit s^{-1} (completion planned for August 2009)
- ***Antenna Conversions***
  - 21st and 22nd antennas converted to EVLA design and restored to array
- ***Antenna Gear Issue***
  - Pinion gear failure in Antenna 5 azimuth gear box occurred 15 April, 2009
    - Antenna has been restored to operations; AZ bearing also replaced as part of servicing
    - Risk: Slip in EVLA readiness schedule
    - Risk Mitigation: have instituted more frequent gear box inspections and an accelerated oil change program; will continue to monitor all other antennas

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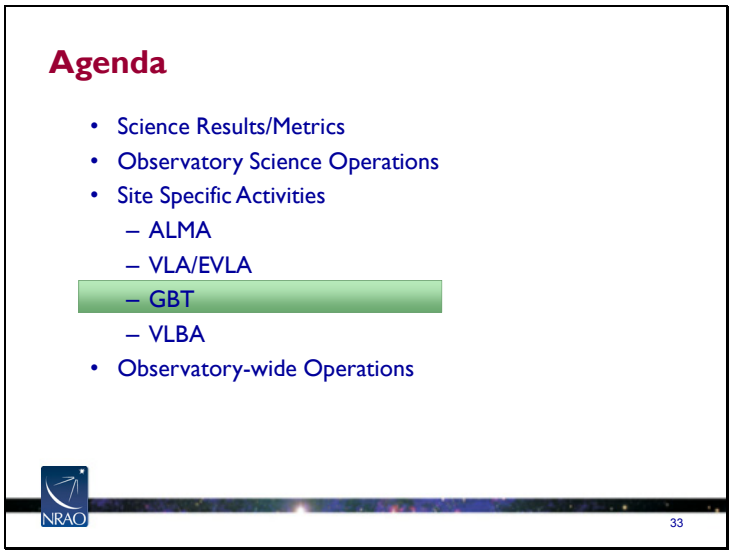
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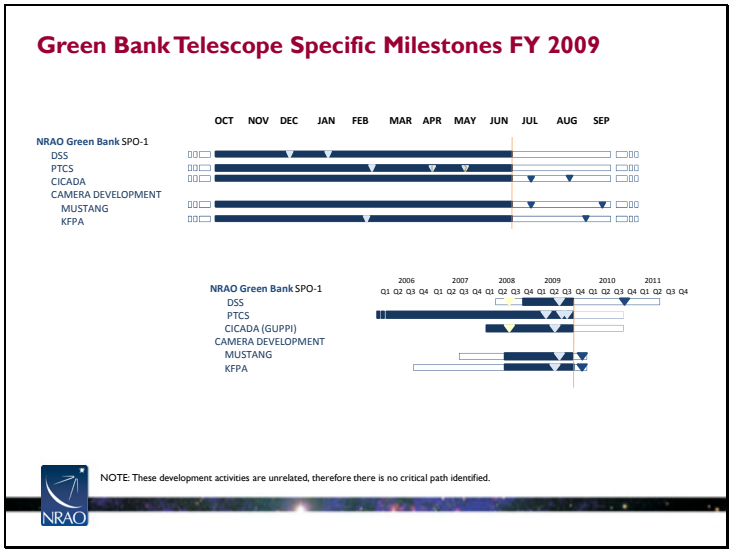
Green Bank Telescope Specific Milestones FY 2009
OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
NRAO Green Bank SPO-1
DSS
PTCS
CICADA
CAMERA DEVELOPMENT
MUSTANG
KFPA
2006 2007 2008 2009 2010 2011
Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
NRAO Green Bank SPO-1
DSS
PTCS
CICADA (GUPPI)
CAMERA DEVELOPMENT
MUSTANG
KFPA
NOTE: These development activities are unrelated, therefore there is no critical path identified.
NRAO

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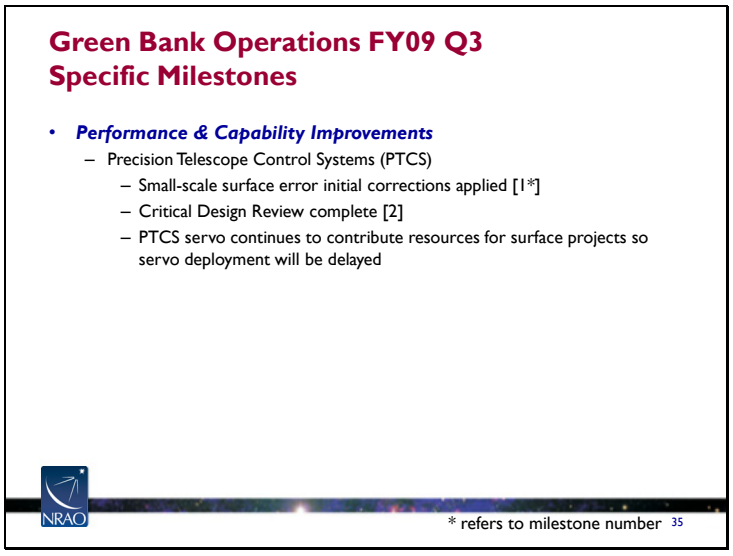

1. Milestone of small-scale surface error initial corrections successfully applied, bringing r.m.s. surface error to 300 microns. This is an Interim milestone in a series of surface smoothness improvements, directly related to PTCS high frequency performance goals. Goal of 210 microns.

2. A Critical design review was held. The PTCS Servo Replacement Design Review was conducted in Green Bank on May 12-13. The panel's report validated the technical solutions for the digital servo, offering some suggestions of points to monitor for system maintainability. The panel suggested a re-scheduling effort was appropriate to better reflect the information gained from earlier task completion durations to inform the remaining project tasks. This rescheduling activity is underway. Report is available at:
http://wiki.gb.nrao.edu/pub/PTCS/DesignReview/ReportoftheDesignReviewPanelGBTPTCSDigitalServoReplacementProject.pdf

Servo continues to contribute resources for surface projects so servo deployment will be delayed. This is why the schedule for the servo system has been stretched from its original delivery date. Resource diversion is also being factored into the rescheduling activity.

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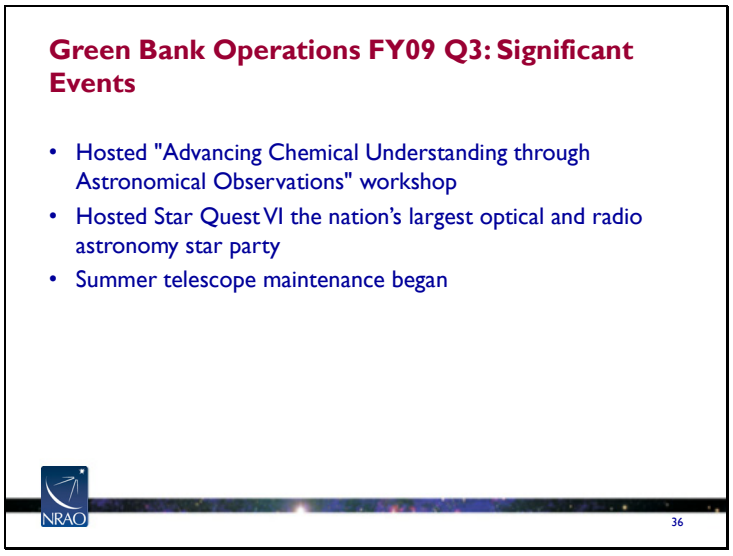

Hosted "Advancing Chemical Understanding through Astronomical Observations" workshop, with approximately 80 participants from around the world.

Summer telescope maintenance began (telescope painting, receiver maintenance, track maintenance)

Star Quest VI the nation's largest optical and radio astronomy star party was hosted by Green Bank on June 24-27. Various lectures and presentations culminating in a lecture by Apollo 12 Lunar Module Commander Alan Bean accompanied the nightly observations by the attendees.

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GB Performance Enhancement Projects 2009 Financial View

- Financial data is currently being collected via ETK for the individual development activities
  - This information should start to become available in Q4 or 2010

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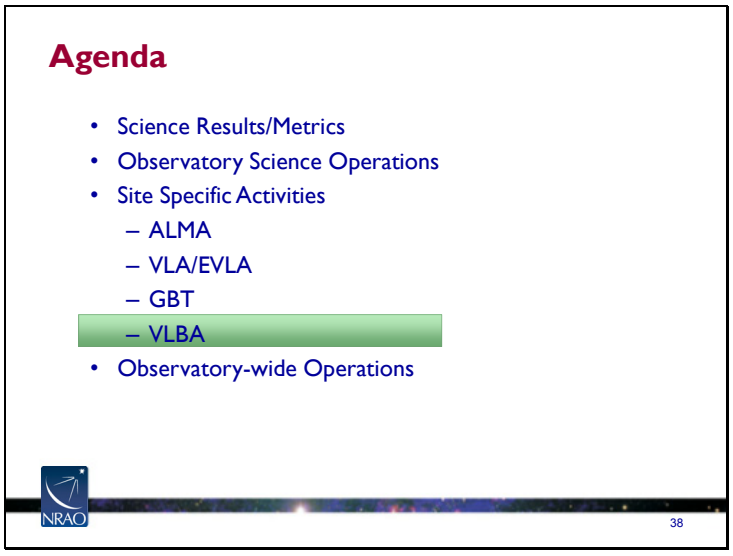
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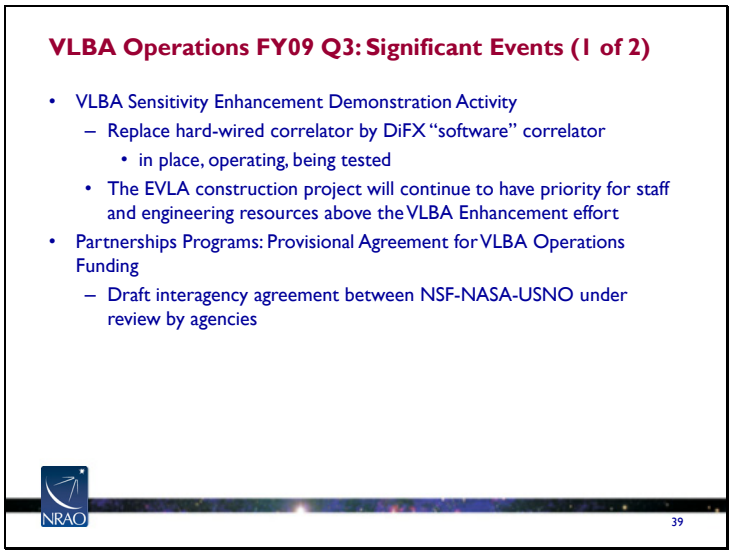

The VLBA sensitivity enhancement activity for Q@ including the replacement of the hard-wired correlator by **DiFX "software" correlator**. It is currently in place, operating, being tested. Capability will be present, but sustained use will require purchase of additional disk media and expansion of DiFXTape.

Partnership contingent on equipping the VLBA with 33 GHz receiver systems.

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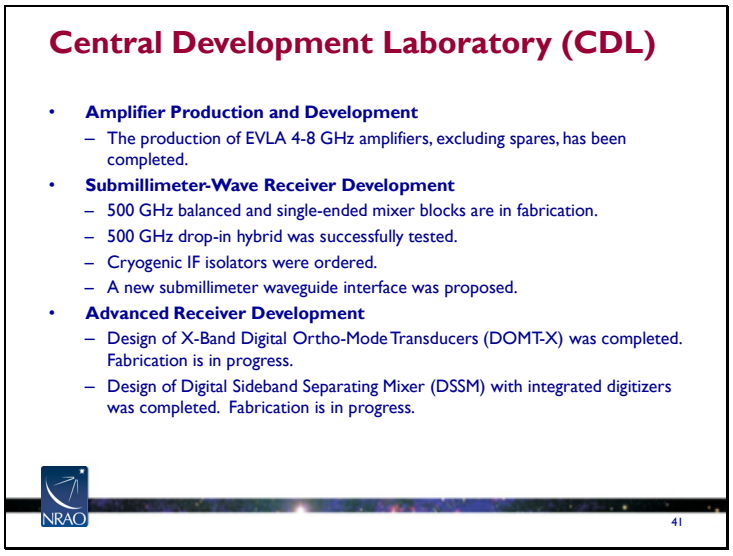

Amplifier Production and Development - New amplifier production included two 1-2 GHz low noise, two 1-2 GHz high dynamic range, two 2-4 GHz, four 4-8 GHz, two 18-26 GHz, six 26-40 GHz and three 38-50 GHz amplifiers. Repair, upgrade, and retesting of amplifiers included one 8-18 GHz, two 18-26 GHz, and four 38-50 GHz amplifiers. In total, 29 amplifiers were shipped. The EVLA amplifier production is slightly behind schedule; however no impact on the EVLA receiver production is expected. The production of EVLA 4-8 GHz amplifiers, excluding spares, has been completed. The deliveries of 38-50 GHz amplifiers in support of the Korean VLBI network and the Max Planck Institute for Radio Astronomy Receiver Group are on schedule.

Submillimeter-Wave Receiver Development - Work continues towards a 350-um SIS mixer. At the University of Virginia Microfabrication Laboratory (UVML), under an NRAO contract, AlN SIS junctions with very high critical current density were demonstrated in the last year, and work continues towards a stable and reproducible process. Also at UVML, work continues on the fabrication of high quality NbTiN for use above ~700 GHz. While UVML develops the new materials and fabrication processes, the CDL is prototyping the 350-um mixer at half the frequency (440 GHz) to optimize a new mixer design using thin silicon membranes and gold beam leads. A 375-500 GHz hybrid on thin-film silicon was measured at room temperature and matched predicted performance. When cooled to 4K, this superconducting hybrid can be used to build a balanced SIS mixer. This is a prototype for a 790-950 GHz (ALMA band 10) superconducting hybrid, again to be used to build a band 10 balanced SIS mixer. A new submillimeter waveguide interface has been proposed which has much greater alignment precision than the standard UG-387 type of flange while being backward compatible with the old standard.

Advanced Receiver Development - Design of the Digital Ortho-Mode Transducer (DOMT-X) modules and the four-channel downconverter needed for testing it are complete. Testing may commence as soon as the downconverter unit is assembled, which awaits sufficient technician support to become available. Design of a Digital Sideband Separating Mixer (DSSM) with integrated analog-to-digital converters in a single compact housing is complete. Parts are on order.

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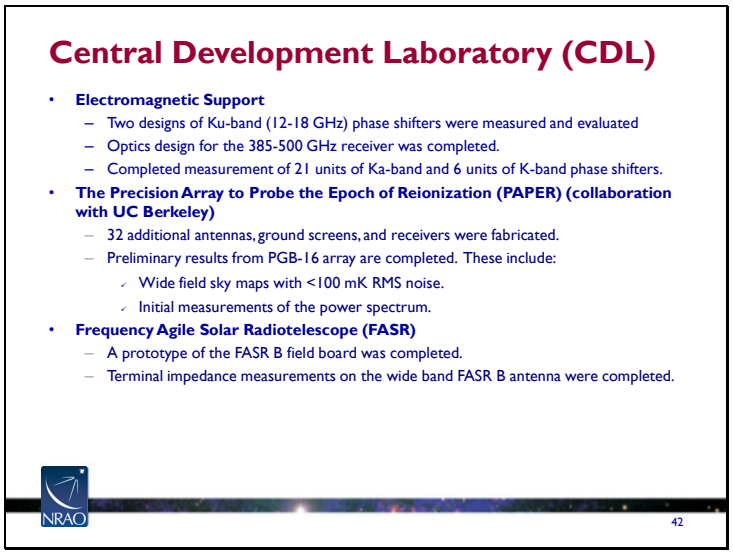

Electromagnetic Support: Two designs of Ku-band (12-18 GHz) phase shifters were measured and evaluated. A longer design was chosen for the EVLA Ku-band receiver because of its better performance. Optics design for the 385-500 GHz receiver was completed. GBT Memo 262 titled "Comparison of GBT L-band feeds: Linear taper horns and Profile Horns" was released.

Completed measurement of 21 units of Ka-band and 6 units of K-band phase shifters.

For the Precision Array to Probe the Epoch of Reionization (PAPER) (collaboration with UC Berkeley), 32 additional antennas, ground screens, and receivers were fabricated. Preliminary results from PGB-16 array are completed. These include: wide field sky maps with <100 mK RMS noise; initial measurements of the power spectrum.

For the Frequency Agile Solar Radiotelescope (FASR) , A prototype of the FASR B field board was completed. Terminal impedance measurements on the wide band FASR B antenna were completed.

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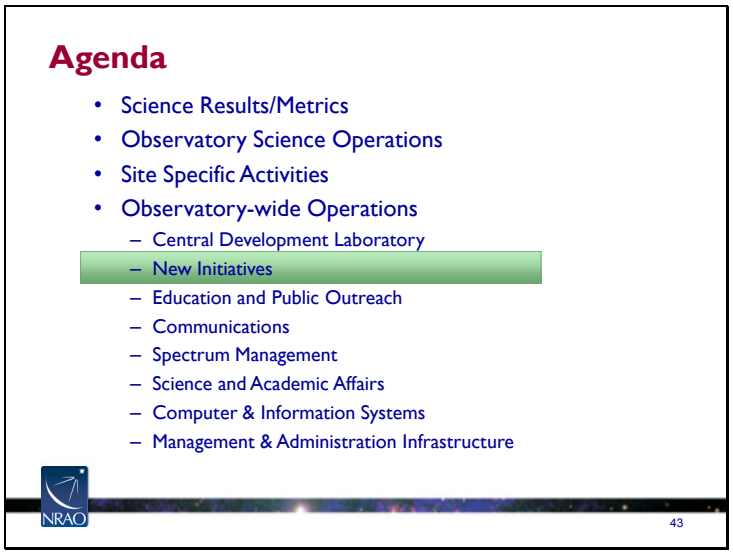
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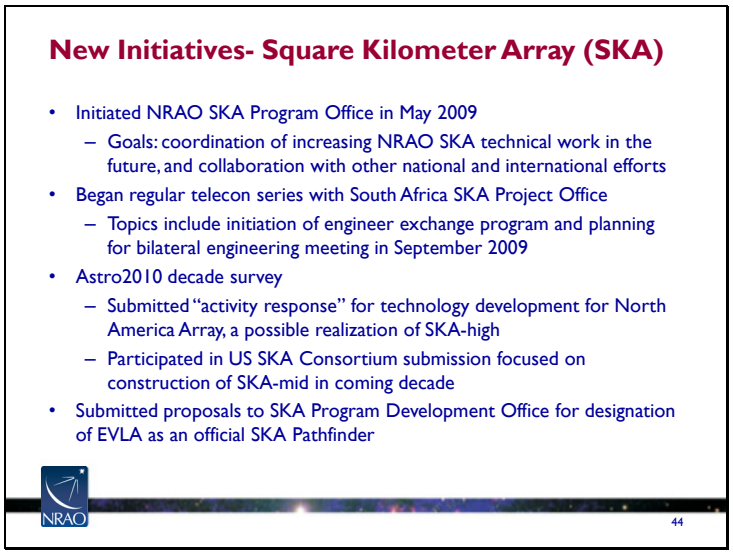

The **NRAO formed an NRAO SKA Program Office** in May 2009, to better coordinate technical efforts within NRAO and collaborations with outside organizations. It is intended that this program office will manage an increasing NRAO involvement in SKA-related work over the next several years, including activities such as the SKA Dish Verification Program at the (E)VLA site.

A regular series of teleconferences was initiated between NRAO personnel and representatives of **the South African SKA Project Office (SASPO).** These telecons will be used to guide implementation of various aspects of the general NRAO-SASPO collaboration agreement that was signed in September 2008. The first two telecons focused on organizational matters, listing and discussing key areas of technical collaboration (e.g., algorithm development, LNAs, digital hardware, telescope commissioning), as well as planning for a face-to-face engineering meeting planned for September 2009.

The NIO participated in two key "activity" submissions to the **Astro2010 decade survey** Program Prioritization Panels. The North America Array submission led by NRAO proposes a technology development program in the coming decade that could lead to SKA-high after 2020. The submission led by the US SKA Consortium focuses on construction of SKA-mid beginning after the middle of the 2010-2020 decade.

The SKA Science and Engineering Committee has established processes for formal designation of SKA pathfinder activities, and for "counting" effort contributed to SKA. NRAO submitted a **proposal for EVLA to be named as a pathfinder telescope**, and another to "count" the effort that senior NRAO staff have contributed in the international SKA planning processes.

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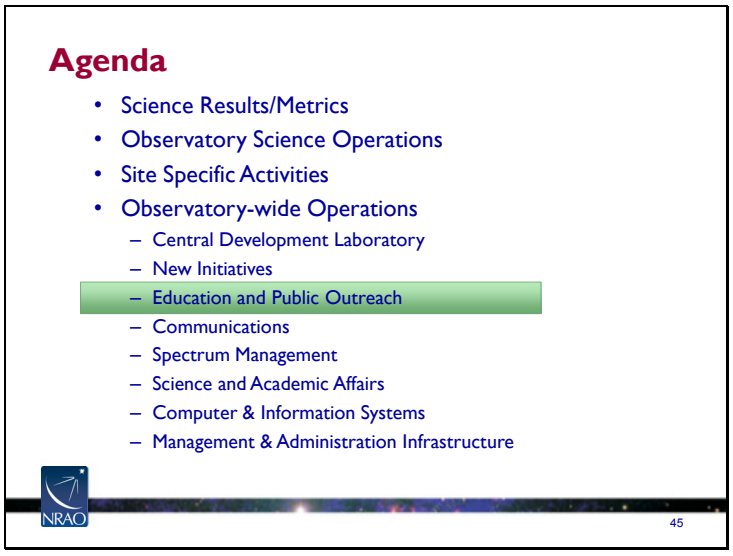
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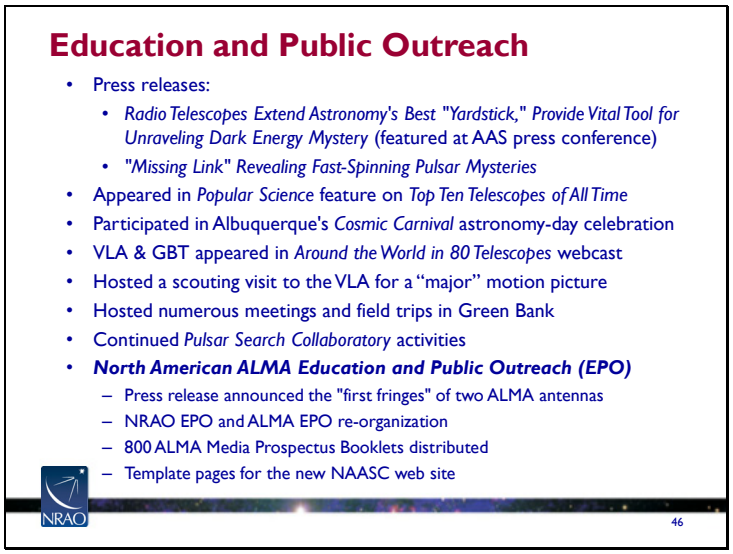

Popular Science feature on Top Ten Telescopes of All Time can be seen at http://www.popsci.com/military-aviation-amp-space/article/2009-04/top-10-telescopes-all-time

Green Bank: Between April and the end of June, several multi-day programs for students, teachers and amateur groups were held. The NRAO hosted: Fairmont State University/Glenville State College "Mini Research Institute", 6th annual Star Quest Star Party (about 180 participants), featuring the NASA Driven to Explore Exhibit which drew about 1200 general public visitors, and the keynote speaker Astronaut Alan Bean (Apollo 12) who spoke to a crowd of about 250. Society of Amateur Radio Astronomy Conference (60 participants) which was held concurrently with the NASA/Glenville State College Summer Science Academy (40 high school students). Jill Tarter was the keynote speaker. Other schools and groups who visited for overnight field trips included: Tygarts Valleye High School (WV), Washington PA Area Middle School Gifted Program (PA), Fayetteville STEM Academy (WV), Grosse Pointe North High School, (MI), Roanoke College, (VA), Gardner-Webb College (NC), South Charleston High School (WV), Waynesburg University (PA), Rutgers University (PA), West Stanley High School (NC), NASA Goddard REU, Several Boy Scout and Girl Scout groups. Also hosted a professional workshop on Astrochemistry and a visit by the American Institute of Physics during this quarter. Participated in the EPSCoR Symposium along with engineers, scientists, STEM college faculty from around the state. Karen O'Neil gave one of the keynote addresses.

Pulsar Search Collaboratory Activities: As of the end of the 2008/2009 school year, over 100 students have become involved in analyzing GBT data as part of the Pulsar Search Collaboratory (PSC), a National Science Foundation funded ITEST program. Forty-eight of these students participated in the 3-day capstone Seminar at WVU in May and presented their work to one another and to professional astronomers. Four students received undergraduate

physics credit for their work. One pulsar candidate has already been discovered by the students. Follow-up observations are under way.

A **press release** announced the "first fringes" of two ALMA antennas at the OSF. NRAO EPO and ALMA EPO began a **re-organization** into a combined single department. About 800 **ALMA Media Prospectus Booklets** were distributed via the International Planetarium Society. Template pages and navigation structure for the **new NAASC web site** were developed.

Public talks were given to the Charlottesville Astronomical Society and at the UVA McCormick Observatory Public Night on “Galaxy Collisions”.

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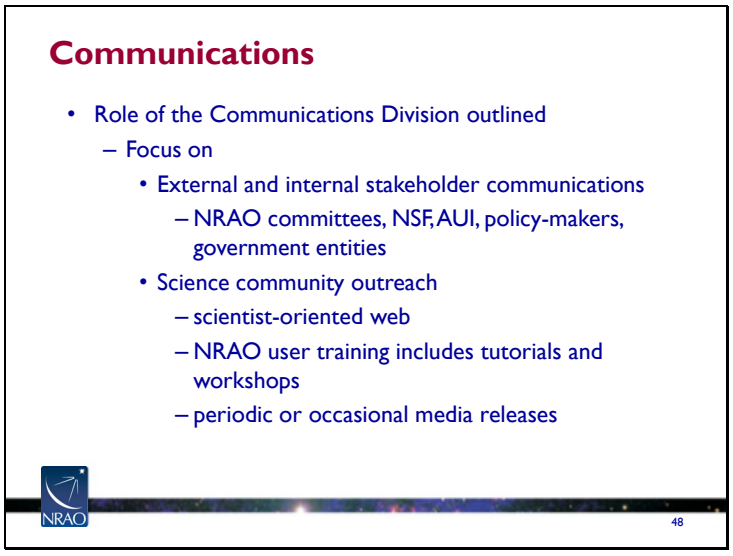

External & Internal Stakeholder Communications

This Observatory-wide activity focuses on communicating NRAO science, technical, and program progress **to external** as well as **internal stakeholders**, including NRAO committees, NSF, AUI, policy-makers and government entities to assure a unified editorial voice helping to maintain and convey the NRAO's identity.

Science Community Outreach

The scientist-oriented web at NRAO must serve users whose radio astronomy knowledge and scientific interests span a wide range, from new users to experts. A new Internet structure which is user-friendly, readily navigable and intuitive is being developed under OSO and will be in place by FY 2010 Q2

NRAO user training includes tutorials for observation preparation and data reduction/analysis, instrument and technique-specific workshops, on-line and live demos, and on-line courses and teaching materials. NRAO must develop and maintain appropriate materials, and prioritize, schedule and staff the tutorials and workshops. The trainers must also be trained to present the material.

Other areas of science community outreach include: periodic or occasional releases such as newsletters and press releases; presentations of seminars at universities and conferences by NRAO staff; booths, Town Halls and special sessions at meetings such as the American Astronomical Society (AAS), American Association for the Advancement of Science (AAAS) and the International Astronomical Union (IAU); feedback from and consultation with the NRAO Users Committee and other advisory committees; and user surveys and polls which assess the success and usefulness of NRAO's user services.

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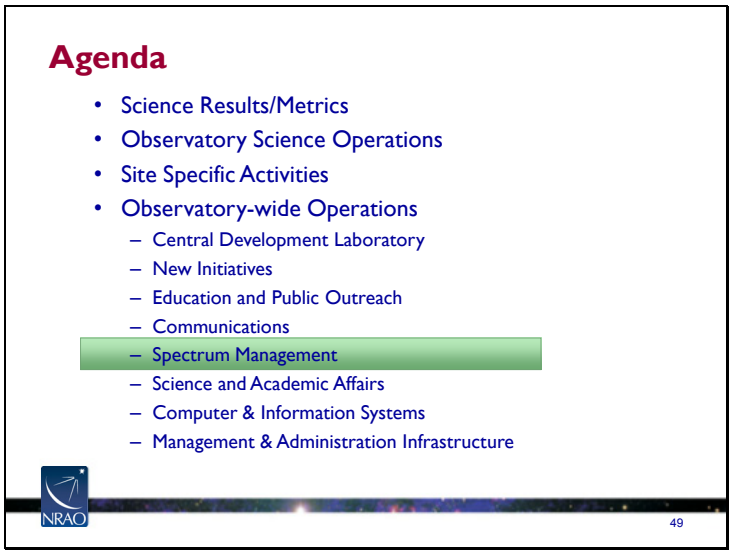
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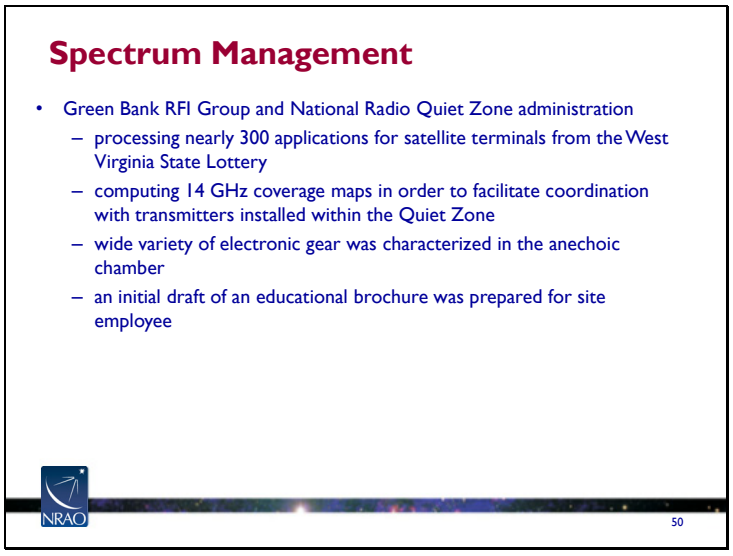

Green Bank RFI Group and National Radio Quiet Zone administration - The NRQZ administrator is processing nearly 300 applications for satellite terminals from the West Virginia State Lottery. New software for NRQZ administration is under consideration. The RFI Group is continuing to compute 14 GHz coverage maps in order to facilitate coordination with transmitters installed within the Quiet Zone under geographic area licensing, for instance home satellite broadband internet connections. Modelling of the antenna patterns of these stations is underway. The RFI Group located 12 more local telephone company wireless modems and discussed these with site management. Spectrum plots of RFI were updated and archived. A wide variety of electronic gear was characterized in the anechoic chamber and an initial draft of an educational brochure was prepared for site employees. Use of the anechoic chamber was demonstrated for two Pocohantas High School students.

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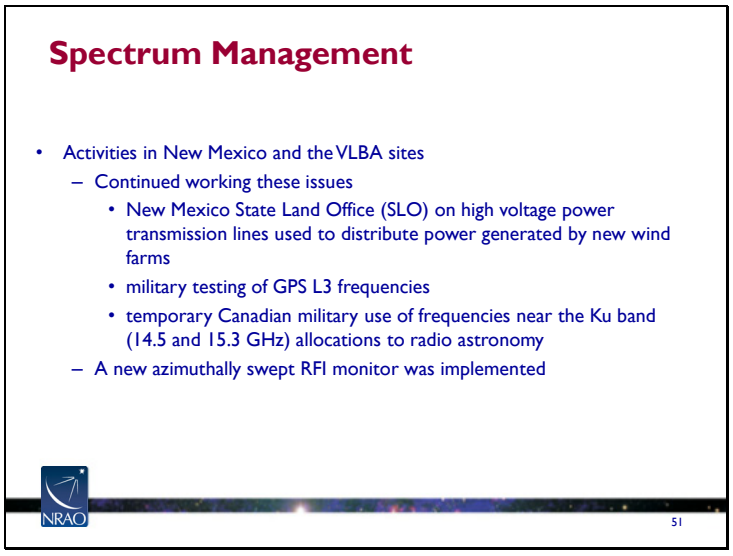

Activities in New Mexico and the VLBA sites - VLA management is continuing to work with the New Mexico State Land Office (SLO) in order to protect the EVLA site from incursion of high voltage power transmission lines that cross the Plains of San Augustin used to distribute power generated by new wind farms. Coordination with military testing of GPS L3 frequencies continued, along with coordination between VLBA stations near the Canadian border and temporary Canadian military use of frequencies near the Ku band (14.5 and 15.3 GHz) allocations to radio astronomy. A new azimuthally swept RFI monitor was implemented.

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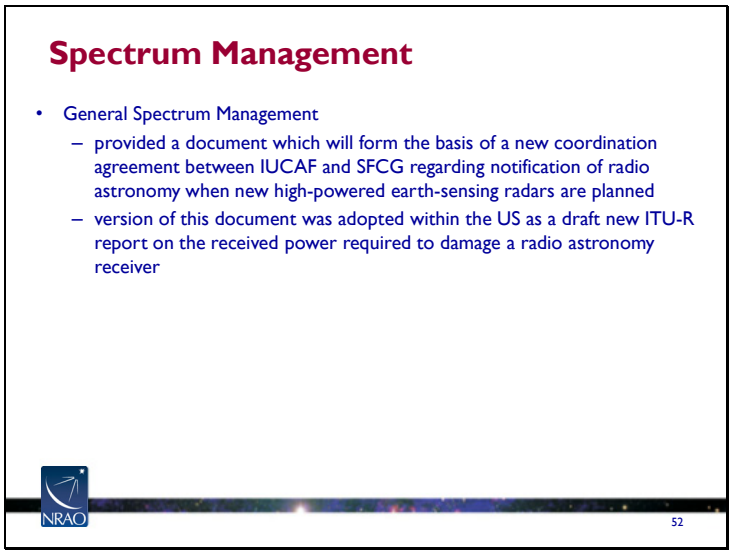

Spectrum Management - The Spectrum Manager provided a document which will form the basis of a new coordination agreement between Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science (IUCAF) and Space Frequency Coordination Group (SFCG) regarding notification of radio astronomy when new high-powered earth-sensing radars are planned. Another version of this document was adopted within the US as a draft new International Telecommunications Union, Radio communications sector (ITU-R) report on the received power required to damage a radio astronomy receiver.

The Spectrum Manager also provided to US WP7D a new document regarding protection of the 6.7 GHz methanol line from a possible new fixed-service allocation to HAPS. NRAO filed a comment with the FCC regarding protection of passive spectrum users in a less heavily-regulated spectrum allocation regime. At the behest of the NRAO Spectrum Manager, the NSF Spectrum Manager, acting through the Interdepartment Radio Advisory Committee (IRAC), received U.S. National Telecommunications and Information Administration (NTIA) approval of an intra-governmental request to FCC for enlargement of the coordination zone at the VLA site for operation of unlicensed TV Broadcast Band White Space Devices. The Spectrum Manager attended the May 2009 NAS Committee on Radio Frequencies (CORF) meeting at NAS in Washington.

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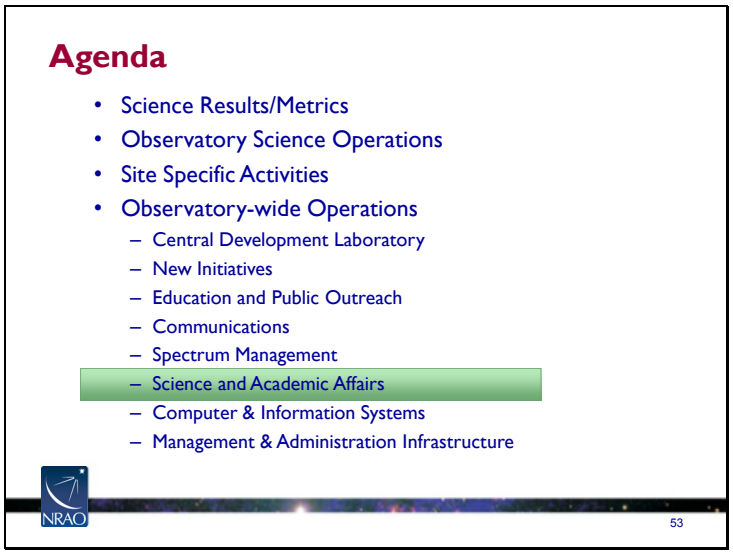
Agenda
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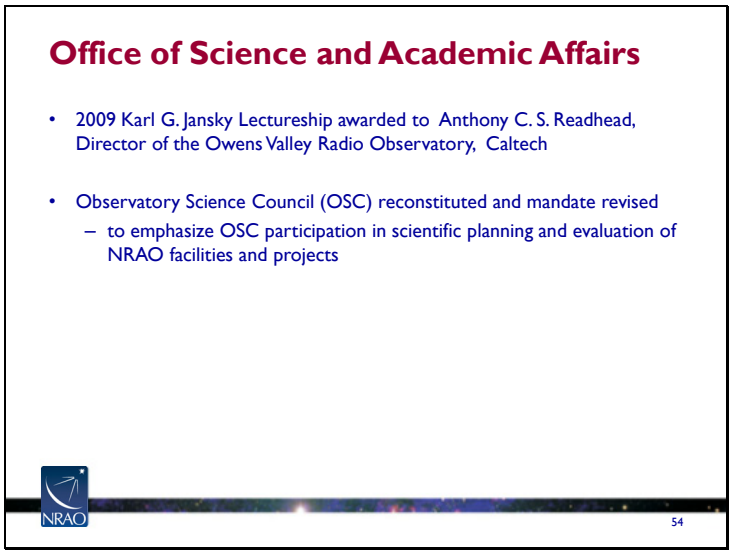

The 2009 Karl G. Jansky Lectureship awarded to Anthony C. S. Readhead, Director of the Owens Valley Radio Observatory, Caltech.

The **Observatory Science Council (OSC)** was reconstituted and mandate revised to emphasize OSC participation in scientific planning and evaluation of NRAO facilities and projects, based on the NRAO mission and long range vision established in e.g. ,the NRAO impact statement submitted to A2010.

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Office of Science and Academic Affairs

- Scientific Staff
  - 2009 Jansky Fellowship Program
    - The early departure of a 2008 Jansky Fellow this summer (to a faculty position at Western Illinois Univ) provided the opportunity for an additional Jansky Fellow. The appointment was accepted by Glenn Jones. He will be resident at Caltech this fall.
  - Student and Visiting Scientist Programs
    - NRAO Summer Student Program
      - Undergraduate and graduate summer students are onboard to pursue their research projects in collaboration with scientists in Green Bank, Socorro, and Charlottesville
    - Predocs
      - New Mexico Tech student continues work in Socorro and with ATNF staff investigating parameterized deconvolution in radio synthesis imaging, specifically for high-dynamic-range and multi-frequency imaging with the EVLA.

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Office of Science and Academic Affairs (cont.)

- Predocs (cont.)
  - UVA student continues work in Charlottesville at the NRAO Technology Center on instrumentation for low-frequency radio astronomy arrays.
  - UVA student worked at the NRAO Technology Center on development and fabrication of ultra-wide-band feeds for a variety of radio astronomy applications.
  - Student from Vanderbilt University completed graduate internship in August and transferred to a pre-doctoral position to continue working with Green Bank scientist on HI observations of interacting galaxies with the GBT and VLA.
  - University of Virginia student completed graduate internship last September and transferred to a pre-doctoral position to continue working with Charlottesville scientist on reducing and analyzing VLBI observations of water maser emission from galactic nuclei as part of the Megamaser Cosmology Project.

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Office of Science and Academic Affairs (cont.)

- Graduate Interns
  - UVA student completed a graduate internship in Charlottesville on searches for new globular-cluster millisecond pulsars with the Green Bank Telescope.
  - University of Maryland student began a graduate internship working in Green Bank on digital processing for radio spectroscopy.
  - University of Kentucky visited Charlottesville as a graduate intern to work on VLA Zeeman-effect observations towards the Galactic Center.
  - UNAM student completed a three-week visit to Socorro to conduct research related to PhD thesis with NRAO staff member.
- Visiting Astronomers
  - Three West Virginia Univ faculty (NRAO Adjunct staff) began two-month appointments working in Green Bank via a research agreement with the West Virginia University Research Corporation.
  - A Researcher from Arecibo Observatory and an Astronomer from the Univ of Melbourne completed Visiting appointments in Socorro.

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Office of Science and Academic Affairs (cont.)

- Support Programs
  - Student Observing Support (SOS)
    - The SOS Committee met in May 09 and awarded funds to the following proposals
      - Boston University awarded $12,841 for proposal GBT09B-002, "Discovering Milky Way HII Regions"
      - Franklin and Marshall College awarded $4,800 for proposal GBT09B-003, "On the Trail of the Enigmatic Millisecond Binary Pulsar PSR J1723-28"
      - University of Minnesota, awarded $25,200 for proposal GBT09B-012, "Relativistic Probes of the WHIM (redux)"
      - West Virginia Universityawarded $22,400 for proposal GBT09B-028, "Timing of New and Old Rotating Radio Transient Sources"
      - University of Massachusetts, awarded $16,970 for proposal VLBA09B-126, "Probing the Fundamental Sizes of HI Clouds in External Galaxies at . . ."
      - Greg Ziemann (University of California, Davis, Supervisor: Robert Becker) was awarded $35,000 for work related to proposal AB1314 (VLA09A-106), "A FIRST Complement to SDSS-III"

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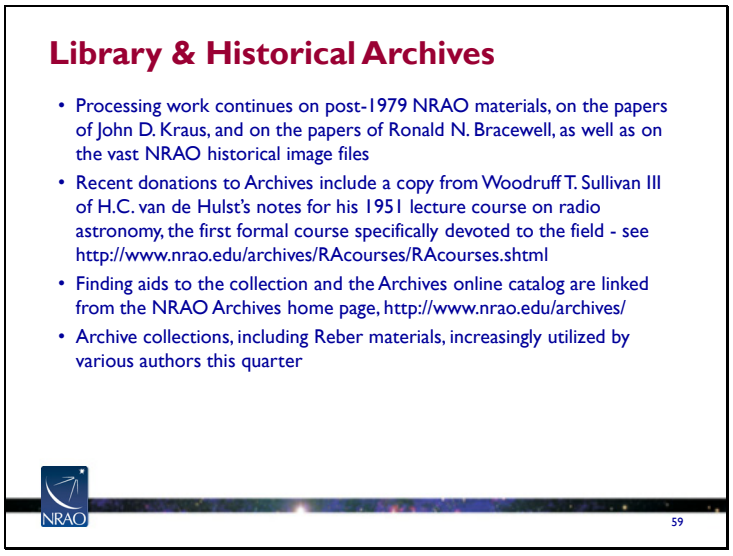

Processing work continues on post-1979 NRAO materials, on the papers of John D. Kraus, and on the papers of Ronald N. Bracewell, as well as on the vast NRAO historical image files.

Recent donations to Archives include a copy from Woodruff T. Sullivan III of H.C. van de Hulst's notes for his 1951 lecture course on radio astronomy, the first formal course specifically devoted to the field - see http://www.nrao.edu/archives/RAcourses/RAcourses.shtml. Finding aids to the collection and the Archives online catalog are linked from the NRAO Archives home page, http://www.nrao.edu/archives/. Archive collections, including Reber materials, increasingly utilized by various authors this quarter.

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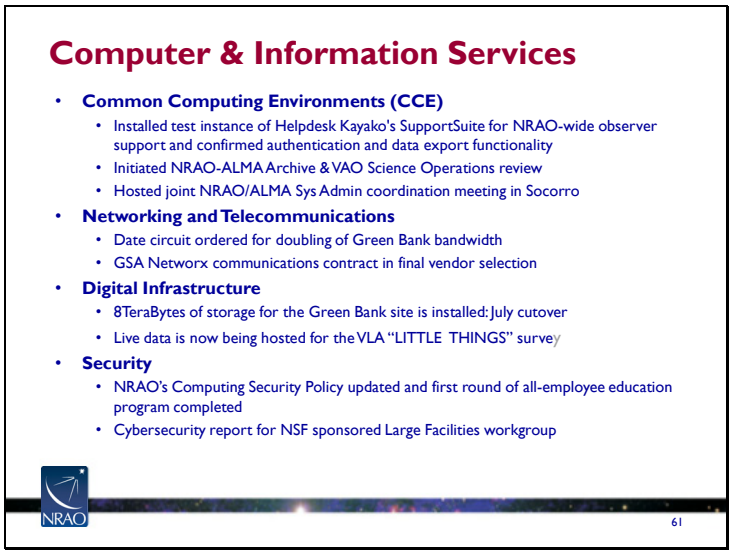

CCE: No critical outages or security violations occurred in this quarter. Average service availability was in excess of 99.9%. CIS partnered with E2E to install and evaluate an **NRAO-wide observer support helpdesk** solution (Kayako SupportSuite). NRAO-wide working group was initiated to address the challenge presented by **Science Data Archive** and access over the next 3-5 years. The New Mexico site hosted the **System Administrators Conference** with representation from Socorro, Green Bank, Charlottesville and four lead admins from Chile to ensure alignment and cross pollination of solutions and technologies**.**

Networking and Telecommunications: The upgrade circuit order for the Green Bank **WAN link to DS3 (45Mbps) speeds** was placed with scheduled go-live of August 12th. Full circuit inventory for all **GSA Contract communication services** validated and bid to five primary vendors. Best and final bids requested from top 2 respondents. Cutover to begin ~September 2009

Digital Infrastructure: **8 TeraBytes of disk storage installed in Green Bank:** Go-live in July pending coordination with the observation schedule. Live data is now being hosted of ~4TeraBytes of **VLA survey data for LITTLE THINGS** (Local Irregulars That Trace Luminosity Extremes The HI Nearby Galaxy Survey) to support the distributed analysis of science data product.

Security: Updated **NRAO Computing Security Policy** and completed the first round of related all-employee **computer security education program**. Participated in **NSF Large Facilities Workshop** and presented report-out for Cybersecurity working group.

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Observatory Management Services

- **Environmental Safety and Security**
  - **New Mexico**
    - Emergency evacuation drill at SOC completed- May
    - Developed Banding Machine Operating Procedures May
    - Completed EPA monthly generator log – June
    - VLA site safety meeting April Hazard Communication – April
    - VLA site safety meeting May Housekeeping and Fall Hazards - May
    - VLA site safety meeting June Fire Extinguishers and Evacuation Procedures – June
    - Site building inspection – pump building and lift station – April
    - Site building inspection – AAB and Transporter Building – May
    - Site building inspection – Annex Building – June
  - Green Bank
    - Updated Green Bank site specific safety manual – June
    - Site C02 system inspected – April
    - Site fire alarm system inspection – May
    - Inspection of site AED units - June

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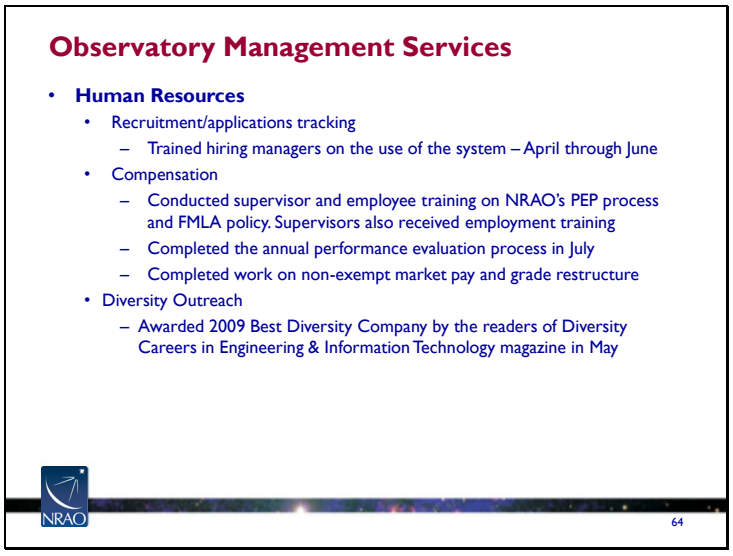

HR completed implementation of its new **recruitment system** on March 31. Manager training was conducted at each facility location between the months of April and June. The web-based system supports the job requisition, posting, position description, application tracking, and candidate evaluation and selection processes. The system will also offer supervisor self-service in the recruitment and selection processes. It will also play an important role in supporting NRAO recruitment and employment of females and minorities.

HR initiated the **annual performance evaluation** process in March. In support of the NRAO Diversity Plan and AUI Broadening the Base Plan, manager and employee training sessions were conducted in April and May to assist employees in preparing a more effective self evaluation and managers in providing effective feedback. The training also included FMLA for employees and managers and hiring for managers (only.) On-site training was provided at the Charlottesville, Green Bank, Socorro and VLA locations. A live video link was provided for NRAO staff in Chile. NRAO completed the annual performance evaluation process (PEP) in FY09 3rd quarter.

HR is in the final stages of completing its review of **NRAO's compensation structure and market pay**. Work on the non-exempt staff was completed in the 3rd quarter. NRAO's acceptance in the Pearl Meyers Research and Development Survey this year is being used to complete the work on the exempt staff review. The 2009 survey is scheduled for release in September 2009, at which time HR will complete the entire review process.

For the third consecutive year, NRAO was **Awarded 2009 Best Diversity Company** by the readers of Diversity Careers in Engineering & Information Technology magazine. Dr. Aaron Evens was selected for an interview by the magazine's editor, which will appear in the fall edition.

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Mgmt & Admin. Infrastructure (cont.)

- **Human Resources**
  - Diversity Employment Results
    - Promotions –
      - Administrative - 2 Female [CV]
    - New Hires –
      - Administrative – 1 Female , African American [CV]
      - Intern – 3 Asian (2 Female) [GB]
      - Scientific – 1 Asian [AOC]
      - Software Engineer – 1 Hispanic [AOC]
      - Mechanic - Hispanic [VLA]

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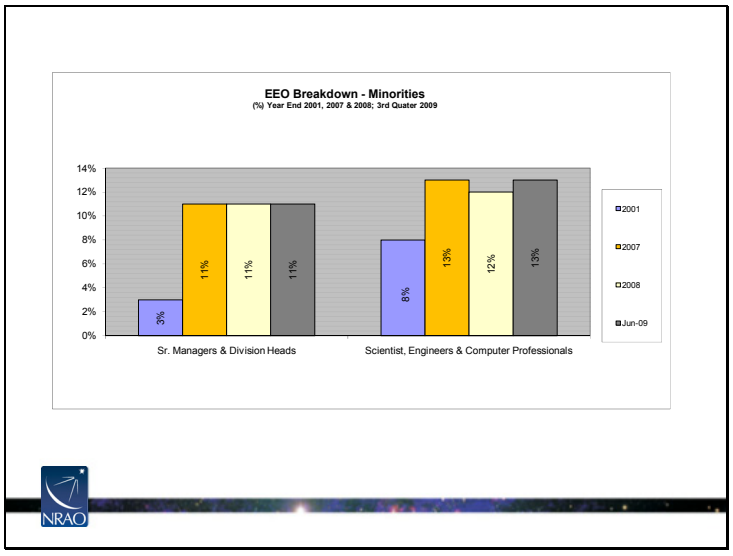

The following Affirmative Action information reflects the continued minority diversification efforts of the Observatory in the science and professional/technical workforce. The Observatory continues to sustain its progress in hiring and retaining minorities in two key groups: Sr. Managers & Division Heads; and Scientific, Engineers and Computer Professionals. NRAO hired one minority to the scientific staff during this quarter.

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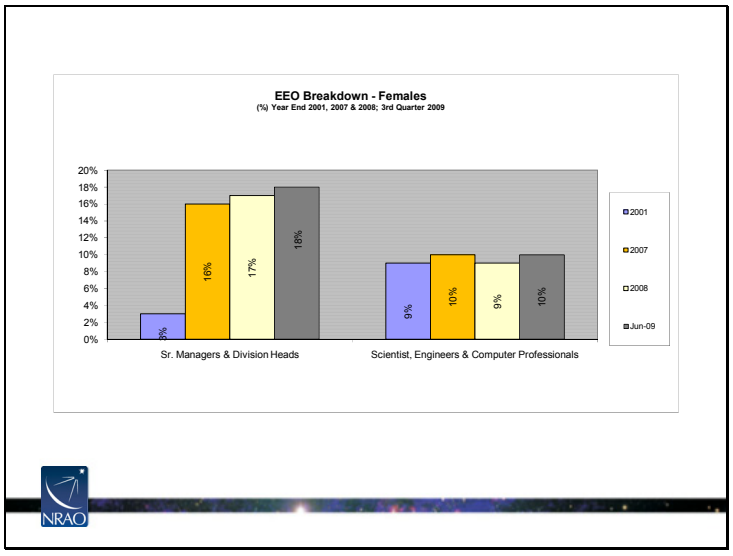

The following Affirmative Action information reflects the continued female diversification efforts of the Observatory in the science and professional/technical workforce. The Observatory continues to sustain its progress in hiring and retaining females in two key groups: Sr. Managers & Division Heads; and Scientific, Engineers and Computer Professionals. No changes in Sr. Manager & Division Head positions occurred in the 3rd Qtr FY09.

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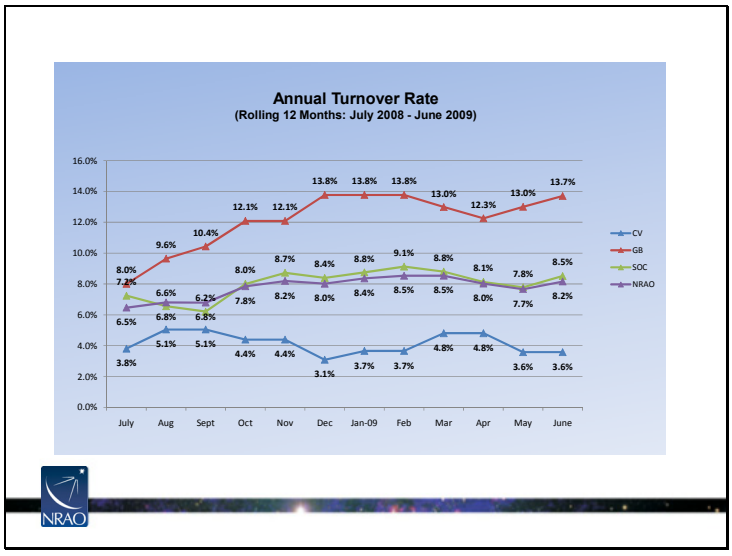

The NRAO turnover decreased by 0.3% in Q3 FY09. The loss of 3 employees in Charlottesville increased attrition at this site by 2.4%. Charlottesville turnover was zero; Green Bank lost 4 employees, two of which were female; and Socorro/VLA lost 5 employees, one of which was a Hispanic male.

Any employee (including seasonal) that has terminated employment with the Observatory is captured in this category. For example, number people that left in that month/total employees at end of month.

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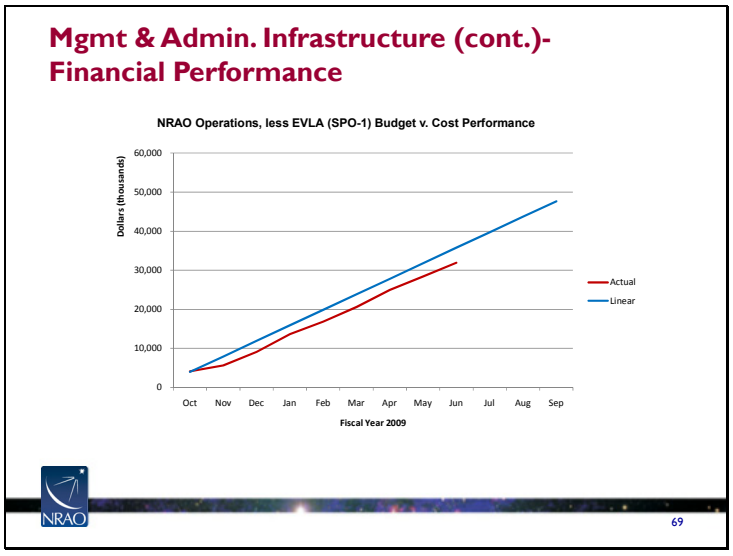

NRAO Operations, less EVLA (SPO-1) Budget v. Cost Performance

NRAO Operations (SPO-1) approximately 10.1% behind linear spending line of 75% for the end of 3rd quarter. Primary factors: Advance collection of Directly Associated Costs (DAC) from ALMA Construction and ALMA Operations to off-set cash flow issues related to continuing resolution earlier in fiscal year. Leave pool variance is running a positive variance that will be distributed (or collected in the case of under recovery) to the business units generating the variance. Science and site seasonal program expenditures will reduce positive variance during summer months.