

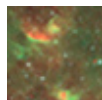
## Upcoming Events



**Building on New Worlds, New Horizons** (<http://science.nrao.edu/newsience/>)  
March 7 - 10, 2011 | Santa Fe, NM



**2011 Postdoc Symposium** (<http://www.nrao.edu/meetings/pdsym2011/>)  
Apr 11 - 13, 2011 | Charlottesville, VA



**Innovations in Data-Intensive Astronomy** (<http://www.nrao.edu/meetings/bigdata/>)  
May 3 - 5, 2011 | Green Bank, WV



**Sixth NAIC/NRAO School on Single Dish Radio Astronomy** (<http://www.nrao.edu/meetings/sds6/>)  
Jul 10 - 16, 2011 | Green Bank, WV

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## NAASC Announces ALMA Community Day Events

Kartik Sheth

To prepare the North American community to fully participate in the Early Science call for proposals, the North American ALMA Science Center (NAASC) is collaborating with the community on ALMA Community Days events leading up to the expected 30 June 2011 ALMA Early Science Cycle 0 proposal deadline.

ALMA Community Day(s) events are one to two day events organized and led by Community Day proposers with a focus on the Early Science capabilities of ALMA, mm/submm interferometry observing techniques, and the tools required to design ALMA observing programs and submit proposals.



The NAASC is supporting these events by providing staff to describe ALMA Early Science capabilities and NAASC community support programs, and lead brief demonstrations and/or tutorials on the ALMA Early Science user tools, including the ALMA Observing Tool for proposal generation and SIMDATA in CASA for simulating observations.

The North American ALMA Science Center is pleased to announce the 2011 community events days listed below.

Some of these events will include a hands-on tutorial component for training on ALMA proposal tools. Space for the hands-on workshops may be limited and local participants may be given a preference.

**Registration will close three weeks prior to the date of an event. Registration for these up-coming 2011 Community Events Days is now officially open and available [here](http://science.nrao.edu/alma/training/pre-registration.shtml) (<http://science.nrao.edu/alma/training/pre-registration.shtml>) .**

**February 24-25:** NRAO, Charlottesville, VA  
Contact: **Kartik Sheth** (<mailto:ksheth@nrao.edu>)

**March 7:** University of Pennsylvania, Philadelphia, PA  
Contact: **Tony Mroczowski** (<mailto:tony.mroczowski@gmail.com>) / **Kim Scott** (<mailto:scoki@sas.upenn.edu>)

**March 11:** Santa Fe, NM

Contact: **Kartik Sheth** (<mailto:ksheth@nrao.edu>)

**March 15-16:** California Institute of Technology, Pasadena, CA

Contact: **John Carpenter** (<mailto:jmc@astro.caltech.edu>) / **Eric Murphy** (<mailto:emurphy@ipac.caltech.edu>) / **Carrie Bridge** (<mailto:bridge@astro.caltech.edu>)

**April 18:** Space Telescope Science Institute, Baltimore, MD

Contact: **Rachel Osten** (<mailto:osten@stsci.edu>)

**April 20:** Harvard-Smithsonian Center for Astrophysics, Boston, MA,

Contact: **Sean Andrews** (<mailto:sandrews@cfa.harvard.edu>)

**April 26-27:** NRAO, Charlottesville, VA

Contact: **Kartik Sheth** (<mailto:ksheth@nrao.edu>)

**May 2-3:** University of Florida, Gainesville, FL

Contact: **Jonathan Tan** (<mailto:jt@astro.ufl.edu>)

**May 8-10:** University of Iowa, Iowa City, IA

Contact: **Cornelia Lang** (<mailto:cornelia-lang@uiowa.edu>) / **Daryl Haggard** (<mailto:dhaggard@northwestern.edu>) / **Tony Wong** (<mailto:wongt@astro.illinois.edu>)

**May 9-10:** NRAO, Charlottesville, VA

Contact: **Kartik Sheth** (<mailto:ksheth@nrao.edu>)

**May 12-13:** University of Arizona and NOAO, Tucson, AZ

Contact: **Joan Najita** (<mailto:najita@noao.edu>) / **Xiaohui Fan** (<mailto:fan@as.arizona.edu>)

**May 23-24:** AAS meeting, Boston, MA

Contact: **Kartik Sheth** (<mailto:ksheth@nrao.edu>)

**May 27:** Columbia University, NY

Contact: **Andrew Baker** (<mailto:ajbaker@physics.rutgers.edu>)

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## ALMA Early Science Plan & Construction Update

Al Wootten

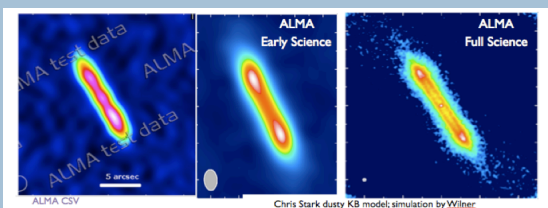
The **Joint ALMA Observatory (JAO)** announced (<http://www.almaobservatory.org/en/announcements-events/250-plan-for-alma-early-science-cycle-0>) that it expects to start Early Science observations (Cycle 0) on a best effort basis late in 2011. A call for proposals will be issued on 31 March 2011. ALMA Early Science Cycle 0 is expected to span nine months. It is anticipated that 500-700 hours of array time will be available for Early Science projects.

The ALMA Early Science Cycle 0 capabilities will comprise

- sixteen 12-m antennas,
- receivers at wavelengths of about 3, 1.3, 0.8, and 0.45 mm (bands 3, 6, 7, and 9),
- baselines up to 250m,
- single field imaging, and
- a restricted set of spectral modes meeting a range of scientific goals.

Additional capabilities including somewhat longer baselines, limited mosaic imaging, and some polarization capabilities, may be announced in the Call for Proposals.

For additional details, please see the **JAO** (<http://www.almaobservatory.org>) and **NRAO North American ALMA Science Center** (<http://science.nrao.edu/alma>) websites.



([images/earlyscience1.png](#))

Figure 1: Left: Recent ALMA test data at 0.85 mm of Beta Pictoris. Middle and Right are ALMA Early (16 antennas) and Full (50 antennas) science simulations of Beta Pictoris at 0.85 mm using a dust model by Chris Stark. These simulations were created by David Wilner (Harvard-SAO) using CASA.

[Zoom \(images/earlyscience1.png\)](#)



([images/earlyscience2.png](#))

Figure 2: A ninth antenna (far right) joined the eight undergoing commissioning work at the Array Operations Site on 12 Dec 2010. The antenna was placed about half-kilometer from the cluster to test some longer baseline elements of ALMA Commissioning. It has since been moved to the compact cluster, as one antenna has returned to the Operations Support Facility for planned upgrades. Image courtesy ALMA (ESO/NAOJ/NRAO).

[Zoom \(images/earlyscience2.png\)](#)



([images/earlyscience3.png](#))

Figure 3: An overview of the OSF. [Left] Antenna contractor areas, showing the many antennas under construction. [Right] The OSF technical area, where accepted antennas undergo integration of ALMA equipment and testing in a two-element interferometer. After this stage, they are transported to the AOS for final testing and commissioning. Image courtesy ALMA (ESO/NAOJ/NRAO)

[Zoom \(images/earlyscience3.png\)](#)

The first release of ALMA test data to the astronomy community will be through the **Science Verification program** (<http://www.almaobservatory.org/en/announcements-events/251-alma-scientific-verification>). Science

Verification will involve observations of objects designed to test ALMA systems and confirm their performance. The first data from these tests will be available by the time of the ALMA Early Science Cycle 0 Call for Proposals. ALMA Test Images provide an excellent means to visualize ALMA's progress toward Early Science. Several of these images have been released by the JAO. Figure 1 shows one of these early images, the debris disk around the southern star Beta Pictoris imaged at a wavelength of 0.85mm. Also shown are simulated images shown by David Wilner at the AAS meeting and at the Spectroscopy 2011 workshop that followed. These images show current performance and suggest expected Early Science and Full Science performance of the ALMA Array.

More than half of the contracted 66 antennas are now at the ALMA site, in various stages of completion, with more en route. A ninth completed antenna, DV(Vertex)09, joined the eight antennas already undergoing commissioning at the 5000 m **Array Operations Site (AOS)** (<http://almaobservatory.org/en/live-from-the-alma-site/live-from-chajnantor>) on 2010 December 12. This antenna was placed on station A109, 600m distant from the compact array, to test phase correction techniques. In January it moved to a station in the compact commissioning configuration vacated by an antenna that was returned to the Operations Support Facility (OSF) for upgrades. At that facility, the eleventh and twelfth antennas from Vertex were recently accepted.

One focus of recent activity has been the upgrade of ALMA software to introduce new functionality, including that needed for Early Science. The software is first tested on the two-element interferometer at the OSF, and is then deployed at the AOS on the commissioning array. Although the season of challenging weather is under way at ALMA, good progress is being made.

An additional task is to test functionality of new software due for deployment on the commissioning array. The new software release will enable functionality needed by scientists for their Early Science research.

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## Extending the Limits of Astrophysical Spectroscopy

Anthony Remijan



More than 125 participants from countries around the world participated in a scientific and technical meeting on the upcoming spectroscopic capabilities of ALMA held 15-17 January 2011 in Victoria, British Columbia. With the call for ALMA Early Science proposals scheduled for 31 March 2011, it was the ideal time for scientists to discuss the upcoming capabilities. ALMA, as well as other NRAO facilities, will provide the scientific community with unprecedented advances in high spatial resolution observations. At the same time, these observations will also provide broadband, high spectral resolution data in frequency ranges that are sparsely covered by any other astronomical facility.

The meeting emphasized the importance of spectroscopy as a vital tool to obtain a better understanding of the nature of astronomical objects. Spectroscopy allows the investigation of the physical and chemical



environments of astronomical objects while at the same time probing kinematics and dynamics and exploring the high redshifted universe all the while obtaining abundances, concentrations and temperatures of exotic molecular species. The range of science talks and discussions were vast as contributed presentations ranged from the investigation of transitions of high redshift CII and CO up to  $z > 6$  to the complex spectra obtained from recent HIFI measurements toward the Orion KL region. In addition, invited speakers gave an overview of the current state-of-the-art observations and what can be expected in the ALMA era in the following scientific areas:

- The Atomic Universe: Atomic Spectra as Probes of Cool Gas
- The Molecular Universe: Dense Star-forming Gas
- Isotopic Variety in the Interstellar Medium
- Our Molecular Origins: Prebiotic Molecules

The invited talks presented the participants with the idea of investigating the complex chemistry on parsec scales towards external galaxies and the hope of identifying an even more exotic and pre-biotic chemistry toward molecular clouds within our own Galaxy given the high sensitivity and high spatial resolution observations that will soon be available with ALMA. Finally, ALMA Early Science capabilities were introduced with a comparison of what is currently possible with existing facilities.

Participants were also introduced to the synergy between all NRAO facilities. ALMA and the EVLA will soon be able to record over 8 GHz of instantaneous bandwidth at high spectral resolution and provide high fidelity, high spatial resolution images that are well suited for studies of Galactic, extragalactic and Solar System objects. Participants were informed of the advances taking place at the GBT which is currently offering focal plane array observations at K-band which will provide information on the widespread distribution of molecular species and the expanded spectroscopic capabilities that will extend the frequency range of the GBT up to 92 GHz. Working together, this suite of instrumentation that will soon be available will provide molecular and atomic information of the Universe on angular scales from degrees to sub-arcseconds and from frequencies ranging from 300 MHz to 950 GHz.



(images/spectro.jpg)

“It was remarkable to witness the breadth of science that can be done given the new spectroscopic capabilities of these new facilities. The anticipation from the workshop participants to get their hands on these telescopes was truly inspiring,” said Gordon Stacey, SOC Chair. “The meeting venue, location and organization, i.e., the long breaks and poster sessions, truly made for a workshop-type feel. It was great to see the younger generation presenting their work and new ideas through contributed talks and posters for using ALMA, the EVLA and GBT,” said Gerald Schieven, LOC chair. For more information on the meeting and to access the talks and posters visit <http://www.almatelescope.ca/Spectroscopy2011> (<http://www.almatelescope.ca/Spectroscopy2011>) .

Following the Spectroscopy 2011 meeting in Victoria, B.C., 80 participants from the astronomical community participated in a day-long tutorial on ALMA tools in preparation for the call for ALMA Early Science proposals. The tutorial consisted of short presentations by NAASC staff on the tools and resources available to the user. These included important user tools such as the science website(s), the **Early Science Primer** (<http://almatelescope.ca/ALMA-ESPrimer.pdf>) , **Mousepad** ([http://science.nrao.edu/alma/MousePad\\_2011\\_Final.gif](http://science.nrao.edu/alma/MousePad_2011_Final.gif)) , HelpDesk, Observing Tool (OT), **CASA** (<http://casa.nrao.edu/>) / **SIMDATA** ([http://casaguides.nrao.edu/index.php?title=Simulating\\_Observations\\_in\\_CASA\\_3.1](http://casaguides.nrao.edu/index.php?title=Simulating_Observations_in_CASA_3.1)) , and **Splatalogue** (<http://www.splatalogue.net/>) . After a brief introduction of these tools, more detailed presentations took place on the ALMA OT and the CASA

SIMDATA task. Participants received 4+ hours of hands-on training and instruction where members of the North American ALMA Science Center and Hertzprung Institute of Astrophysics helped troubleshoot problems and provide insight to the attendees who were learning how to prepare an Early Science proposal based on their specific research interests. “The goal of the NAASC tutorials is for the participants to be active in using these tools, and to help them prepare for the opportunities that awaits them in ALMA Early Science,” said Kartik Sheth, NRAO Assistant Scientist and the lead for tutorials, Community Days and training events organized by the NAASC. “If you are planning to attend a NAASC sponsored training event, come prepared to work.”

For more information on all the training events sponsored by the NAASC, visit

<http://science.nrao.edu/alma/community1.shtml> (<http://science.nrao.edu/alma/community1.shtml>)

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## EVLA Science: ApJ Letters Special Issue

Chris Carilli, Claire Chandler, Bob Dickman, Rick Perley, Lori Appel

The Expanded Very Large Array (EVLA) has been operating for about ten months and has covered the C, DnC, and D configurations. The NRAO is organizing a special issue for ApJ Letters, presenting the first scientific results from the EVLA. The special issue constitutes an immediate record of the performance and capabilities of the EVLA, and the exciting scientific work that is already being done.

Our goal is to have the special issue of ApJ Letters appear sometime in summer 2011, and consist of results from the C, DnC, and D arrays. The timescale requires that we have papers submitted by mid-April. The ApJ has agreed to have a coordinated (and expedited) refereeing process, consistent with what they have done for previous special issues.

We have tried to contact all observers from this time frame. If you observed during this time period and did not receive an e-mail directly from NRAO, and if you are interested in participating in the special issue, please send an expression of interest to [apjlevla@nrao.edu](mailto:apjlevla@nrao.edu) (<mailto:apjlevla@nrao.edu>) by **February 15, 2011**.

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## Future of the VLBA Workshop

Ken Kellermann



([images/ken1.png](#))

Figure 1: Mark Reid (CfA) presented the Workshop summary.



[Zoom \(images/ken1.png\)](#)

On January 27 and 28, more than 60 scientists from 12 countries and five continents gathered in Charlottesville, Virginia to discuss the scientific progress of the Very Long Baseline Array (VLBA) and to

reach a consensus for a roadmap for international VLBI and a new operating model for the VLBA. The workshop was motivated by the need to address the recommendations of the 2006 NSF Senior Review and the subsequent instructions from the NSF that NRAO should secure additional outside funding in partial support of the VLBA operations beyond 2011. Already significant external support for the VLBA is being provided by the United States Naval Observatory (USNO) to carry out their daily UT1 measurements, as well as by the Max Planck Institute for Radioastronomy (MPIfR) in support of the Bar and Spiral Structure Legacy Survey (BeSSeL). Purdue University, Stanford University, the University of New Mexico, UNAM in Mexico, and the European RadioNet under the Trans-National access program have also provided support. However, in spite of this generous support, the expected NRAO operating budget for 2011 and beyond is not sufficient to sustain the operation of the VLBA in the normal NRAO Open Skies PI proposal-driven manner.

The snow and ice storm that swept the US East Coast on January 26 delayed the start of the workshop by half a day. Many participants spent the night at airports or hotels at various connecting hubs, and the less fortunate spent up to nine hours driving the 100 miles from Dulles Airport to Charlottesville (one person obtained refuge in the back seat of a police vehicle). Thus, the turnout was truly encouraging, and we are grateful to all the attendees who made this workshop a success.



[\(images/ken2.png\)](#)

Figure 2: Chopo Ma (NASA Goddard) and Makato Inoue (ASIAA, Taiwan) debate an issue.

[Zoom \(images/ken2.png\)](#)

Particularly satisfying was the wide variety of VLBA scientific work reported by the workshop participants. These ranged from the traditional VLBI studies of AGN and maser sources to the determination of supermassive black hole masses and the Hubble Constant, precision distance measurements within the Galaxy, imaging of asteroids, micro-arcsecond astrometry facilitating measurements of the parallax and proper motion of pulsars, the spiral structure and rotation of the Galaxy, and a radio search for extrasolar planets. Even less conventional applications of the VLBA were discussed in reports on the USNO program using the VLBA for their determination of UT1 (on which we all depend) and the international terrestrial and celestial reference frames, along with spacecraft tracking and navigation.

In addition to the VLBA, we heard about the increasing level of activity from other VLBI networks including: the European VLBI Network (EVN); the Australia–NZ Long Baseline Array; the Russian, Chinese, Japanese, and Korean Networks; and the possibility of an extensive VLBI array in Africa using decommissioned telecommunication dishes. Many of these VLBI networks run overlapping programs such as the integration of the Chinese and Russian KVAZAR Network into the EVN. Several speakers reported on the construction of large new radio telescopes in Mexico, Sardinia and Shanghai that will offer substantial improvements to the sensitivity of the global arrays. We were all disappointed, however, to learn that due to increasing costs and technical challenges in meeting the specs, the Japanese VLBI Space Observatory Program-2 (VSOP-2) has been canceled.

On the technical side, we heard about the recent and projected improvements in the VLBA data rates which

now allow a sustainable recording rate of 512 Mbps and which will achieve 2 Gbps later this year. This will give VLBA users a very significant improvement in sensitivity, especially for continuum observations. Thanks to the contributions by Adam Deller and Joe Lazio, the phased EVLA should be available by mid-2011, well ahead of schedule. The new VLBA C-band receivers will facilitate BeSSeL, one of the major key programs on the VLBA to determine the structure of the Milky Way via the observation of methanol masers. In some other areas of the world, especially in Europe, eVLBI has come into routine use. For the foreseeable future, however, it appears that disk-based recording will remain more cost effective for the VLBA, and due to the rapid turnaround of disks within the VLBA, there is no significant loss of time or in the quality of the scientific returns.

Following the workshop, a number of participants pledged their financial support for continuing VLBA operations. This external support, combined with cost-saving measures at the NRAO, is sufficient to enable the continued operation of the VLBA using all ten antennas, but with an emphasis on key science and large programs. While the NRAO will continue its traditional support for US astronomy users based only on scientific merit, it also will recognize those who have contributed to the operation of the VLBA, and less time will be available for competitive proposals, even from US observers.

VLBI has always been an international activity, and the role of the other VLBI networks around the world is growing. It was recognized that we must all work toward a future Global VLBI Array to help coordinate observations that use antennas from more than one VLBI network.

For more information about the workshop including all the presentations, please see

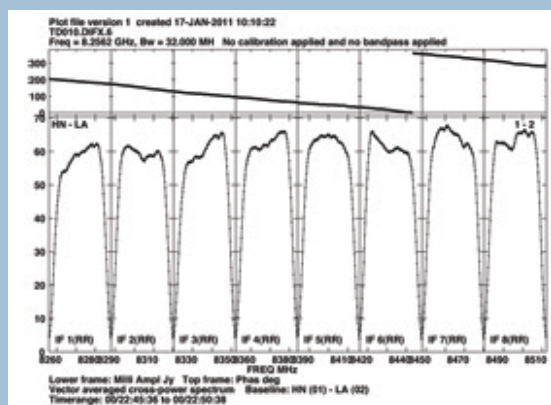
[http://science.nrao.edu/vlbaworkshop\\_2010/index.shtml](http://science.nrao.edu/vlbaworkshop_2010/index.shtml)

([http://science.nrao.edu/vlbaworkshop\\_2010/index.shtml](http://science.nrao.edu/vlbaworkshop_2010/index.shtml))

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## VLBA Sensitivity Upgrade Project Approaching Completion

Jon Romney, on behalf of the VLBA Sensitivity Upgrade team



(images/Romney\_Fig1.jpg)

Figure 1

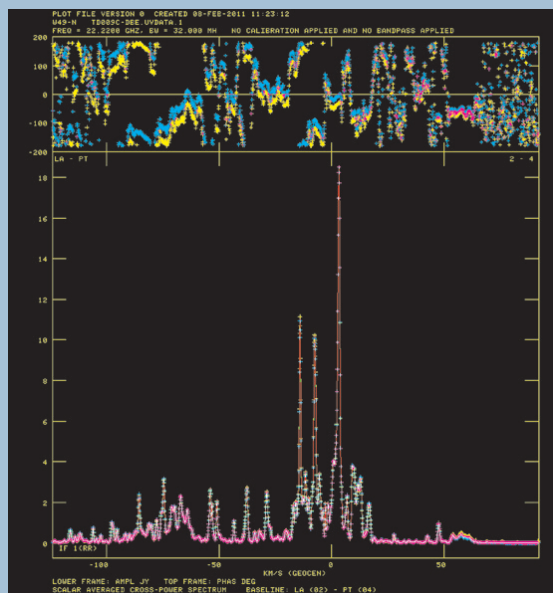
The VLBA's transition to wider-band operation, announced in the 7 January Call for Proposals eNews issue, signals the anticipated completion of the VLBA Sensitivity Upgrade project. The FPGA-based RDBE unit at the heart of the upgrade already supports the main signal path at a 2-Gbps bit rate (equivalent to 256 MHz per polarization), and several essential auxiliary functions are either operational or nearing completion.

The ROACH Digital Backend (RDBE) samples the station's received signals directly from the 512-1024 MHz IF bands, with all subsequent processing performed digitally, and replaces much of the VLBA's original signal processing, in particular the analog baseband converters and the formatter. ROACH refers to the FPGA-based central signal processing board -- Reconfigurable Open Architecture Computing Hardware -- that was developed in a collaboration between NRAO, the South African KAT project, and the CASPER laboratory at UC Berkeley. The RDBE accepts two IF inputs, and provides packetized output via a 10-



Gigabit Ethernet interface. RDBEs are already in place at the BR, HN, LA, MK, PT, and SC stations, with installations scheduled at NL and OV in February, FD and KP in March. Installation at the GBT is also planned, and NRAO has built RDBE units for Arecibo and Effelsberg. Implementation of RDBE units at these High Sensitivity Array stations will require some development of local operational software, and is expected to lag completion of wideband capability on the VLBA itself.

The FPGA personality currently available in the ROACH is a polyphase filterbank (PFB) design, intended to support wideband continuum observations. Currently, it operates in a fixed configuration that forms sixteen 32-MHz sub-bands from each of the two input IFs. Any subset of the total 32 sub-bands, quantized at 2 bits, can be selected for output at a fixed 2-Gbps data rate. The PFB personality was developed mainly by Haystack Observatory, with some assistance by NRAO once personnel became available about a year ago. The recently released SCHED 9.4 already supports most features of the PFB personality.



(images/Romney Fig2.jpg)

Figure 2

NRAO's main part in this FPGA firmware collaboration is a digital-downconverter (DDC) personality, aimed primarily at narrower-band spectroscopy. Although the DDC is still under development, two options are now available for ongoing spectroscopic observations. A generous contribution by Laurent Loinard of UNAM, funded by CONACyT, has made possible a parallel Mark 5A/5C recording configuration, to facilitate continued use of the original VLBA equipment. In addition, the “spectral zoom” mode of the VLBA's DiFX correlator makes possible spectral resolutions as fine as 1 kHz per spectral point for lines observed in the PFB's 32-MHz sub-band width.

The RDBE's 10G Ethernet output packets are recorded on the Mark 5C units, which are also nearing operational status. Mark 5C was developed jointly by NRAO, Haystack Observatory, and Conduant Corporation. It closely resembles earlier Mark 5 systems, and uses identical disk modules, but is functionally more straightforward, simply recording the payload of each 10G Ethernet packet without imposing any special recorder format. All formatting of the observed samples -- most essentially, the precision time tags -- is internal to the packet payloads, which are transmitted directly from the RDBE to the correlator. Mark 5C is also specialized to support direct access to the recorded data from a software correlator. The VLBA DiFX correlator, the first element of the Sensitivity Upgrade to have been brought into operation, is essential for processing the bandwidth enabled by the RDBE and Mark 5C subsystems. A procurement currently in progress, funded through an MRI-R<sup>2</sup> award from the National Science Foundation, will provide sufficient Mark 5 disk modules, and processors for the DiFX cluster, to support continuous operation at a 2-Gbps data rate.

Tests of the new equipment began as early as last summer, with observations involving the initially outfitted VLBA stations, and geodetic stations at Westford, MA, and Goddard Space Flight Center. These tests eventually yielded fringes within, but not between, the two networks. The inter-network problems are believed fixed, but another test has not yet been organized due to logistical difficulties and marginal compatibility. Nevertheless, excellent intra-VLBA results are in hand from ongoing, more recent tests. The RDBE is now performing quite well in a variety of operational cases, while minor bugs in the Mark 5C recorders continue to be identified and corrected. Results from two very recent tests are included with this article. Figure 1 shows the amplitude and phase on one baseline from a 5-station array, for a 1-minute integration on 3C454.3. The eight channels plotted span a contiguous 256-MHz range along the frequency axis in one of the two polarizations observed; the perfect continuity of phase across sub-band boundaries is a very advantageous characteristic of the PFB signal processing. Figure 2 is an example of spectroscopy using the PFB, with 22-GHz water masers in W49N spanning much of a single 32-MHz PFB sub-band. The figure shows a centered 16-MHz subset of that sub-band (yellow points), with parallel observations using a 16-MHz channel in the original VLBA equipment (blue points), plotted on the same axes (with an arbitrary amplitude scale). Pink points, with red connecting lines, represent overlaid data.

Further information on the RDBE, Mark 5C, and DiFX subsystems of the upgraded VLBA is presented in the **Observational Status Summary** (<http://www.vlba.nrao.edu/astro/obstatus/current/>) and will be updated as necessary during the transition.

More general information on the Sensitivity Upgrade is available in the **project's memo series** (<http://www.vlba.nrao.edu/memos/sensi>).

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## Sixth NAIC/NRAO School on Single Dish Radio Astronomy

Karen O'Neil

NRAO and NAIC are organizing the sixth NAIC-NRAO school on single-dish radio astronomy. This will be held from 10-16 July 2011 at the Green Bank Observatory in West Virginia. The objective of the school is to provide graduate students, post-docs, and experts in other fields of astronomy with both knowledge and practical experience of the techniques and applications of single-dish radio astronomy using the Arecibo Telescope and the Robert C. Byrd Green Bank Telescope as the two primary examples. The school will be based around an intensive series of lectures from experts. A significant part of each participant's time at the school will be spent performing a hands-on radio-astronomy project. For this, they will make observations with either the Arecibo 305-m telescope or the Green Bank 100-m (GBT) telescope, analyze the data acquired, and interpret the results. Further information, and registration, is available at <http://www.nrao.edu/meetings/sds6/> (<http://www.nrao.edu/meetings/sds6/>).

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## New GBT Dynamic Scheduling System Features

Karen O'Neil

The GBT Dynamic scheduling system (DSS) has undergone a number of enhancements over the past six months. While many of the changes are “under the hood,” resulting in a decrease in the manual input in scheduling and an increase in the overall observing efficiency of the GBT, there are a number of enhancements that are of direct interest to GBT observers.



- **Electives:** There is now a new type of session called “elective” which allows for a choice between a number of different distinct dates and times on the schedule. This is primarily of interest to high frequency GBT+VLBI observers, but is also quite useful, e.g., for other coordinate observations as well as phase monitoring.
- **Project Blackout dates:** The option now exists to blackout certain dates for a project, rather than on an observer-by-observer basis. This is intended to be used when certain phases of an object are not desirable for observations, and can be used only by request to the helpdesk.

- Observer blackout date, honoring the “enabled” flag: In the past, observer blackout dates and the session “enable” flag were only honored for open sessions. By observer request these two features are now honored by **all** types of sessions.
- New resource calendar: The GBT resource calendar was originally intended for use by local staff, but quickly became popular with many of the GBT observers. The original resource calendar is now completely replaced and has been subsumed by the **DSS schedule** (<http://dss.gb.nrao.edu/schedule/public/>) .
- Non-guaranteed windows and electives: Occasionally a project, while it would like to run in its allotted window or elective time(s), does not wish to run if the weather is not sufficient for the project’s science goals. In this case the session can be run as “non-guaranteed”, which means it will only run if the automatic scheduling system find the weather to be sufficient for the science needs.

Details on the above topics, along with an overarching description of the DSS, can be found at <http://science.nrao.edu/gbt/scheduling/dynamic.shtml> (<http://science.nrao.edu/gbt/scheduling/dynamic.shtml>) .

## The NRAO at the AAS-Seattle Meeting

Mark Adams



([images/NRAO Town Hall2.jpg](#))

Figure 1: NRAO Director Fred Lo provided an overview of the latest Observatory news and science at the NRAO Town Hall.

 [Zoom \(images/NRAO Town Hall2.jpg\)](#)



([images/EVLA Special Session1.jpg](#))

Figure 2: At the EVLA Special Session, Crystal Brogan described the first results of a 24 GHz survey of

massive protostellar objects conducted at an angular resolution of  $\sim 10,000$  AU.

 [Zoom \(images/EVLA Special Session1.jpg\)](#)



[\(images/ALMA Special Session.jpg\)](#)

Figure 3: Kartik Sheth's presentation at the ALMA Special Session provided an overview of the user tools needed for the North American community to plan and propose for ALMA observing time.

 [Zoom \(images/ALMA Special Session.jpg\)](#)

The NRAO sponsored a range of special events and scientific sessions at the well-attended 217th American Astronomical Society (AAS) meeting in Seattle, 9-13 January 2011.

The **NRAO Town Hall** (<http://science.nrao.edu/events/aas217townhall.shtml>) on Tuesday evening, 11 January, attracted 290 AAS attendees and informed the membership about the status of NRAO science and science operations, observatory development and programs, and construction projects. Director Fred K.Y. Lo opened with an overview of the NRAO and recent science results. Crystal Brogan then described the ALMA Early Science opportunities in 2011, including the tools and support available through the North American ALMA Science Center (NAASC). EVLA Scientist Rick Perley wrapped up the session with an energetic presentation about the status of the EVLA commissioning and recent Early Science results.

A **Special Session** (<http://science.nrao.edu/events/aas217evla.shtml>) on Wednesday morning organized by Perley featured a broad sample of compelling EVLA Early Science results, including papers on Trans-Neptunian Objects, grain growth and substructure in protoplanetary disks, a K-Band survey of massive young protostellar objects, classical novae, Type IA supernovae, QSOs, and primeval galaxies.

The 150 persons attending the “**Observing with ALMA** (<http://science.nrao.edu/events/aas217alma.shtml>)” Special Session on Wednesday afternoon heard more about the capabilities available for Early Science, as well as NAASC community support and training. Speakers described the ALMA Observing Tool (OT) for proposal preparation and submission, the Common Astronomy Software Applications (**CASA** (<http://casa.nrao.edu/>)) package for ALMA science data reduction, the "observing simulator" task, **SIMDATA** ([http://casaguides.nrao.edu/index.php?title=Simulating\\_Observations\\_in\\_CASA\\_3.1](http://casaguides.nrao.edu/index.php?title=Simulating_Observations_in_CASA_3.1)), and **Splatalogue** (<http://www.splatalogue.net/>), an on-line Virtual Observatory-queryable spectral line database.

A 90-minute ALMA Early Science proposal preparation tutorial early Wednesday evening provided a filled room of 50 attendees with greater insight into the ALMA OT, CASA, SIMDATA, and Splatalogue.

NRAO Astronomer Scott Ransom delivered his invited Helen B. Warner Prize Lecture -- "Millisecond Pulsars: The Gifts That Keep On Giving" -- on Tuesday afternoon. The prize is awarded annually for "a significant contribution to observational or theoretical astronomy during the five years preceding the award." Presented by AAS President Debra Elmegreen, the Prize recognized Ransom "... for his astrophysical



insight and innovative technical leadership enabling the discovery of exotic, millisecond and young pulsars and their application for tests of fundamental physics."

NRAO press releases at this AAS meeting described Scott Ransom's Warner Prize, and research conducted by Amy Reines (UVA) et al that discovered a surprising supermassive black hole in the Henize 2-10 dwarf galaxy.

AAS meeting attendees visited the NRAO exhibit to obtain additional information about our research facilities and project status, to view NAASC demonstrations, to converse with and ask questions of our staff, and to pick up the latest support materials, including the [ALMA Primer \(http://almatelescope.ca/ALMA-ESPrimer.pdf\)](http://almatelescope.ca/ALMA-ESPrimer.pdf) and the [2011 NRAO Research Facilities \(http://science.nrao.edu/facilities/NRAOResearchFacilities.pdf\)](http://science.nrao.edu/facilities/NRAOResearchFacilities.pdf) brochure.

We look forward to visiting with the AAS community again at the 22-26 May 2011 meeting in Boston, just a month prior to the expected 30 June submission deadline for ALMA Early Science proposals.

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## The Latin American Galileo Teacher Training Program

Sergio Cabezon, AUI/NRAO Education & Public Outreach Officer in Chile

Thirty-three teachers attended the second version of the Latin American Galileo Teacher Training Program Workshop (GTTP) Workshop 3-7 January 2011, an astronomy training initiative for teachers and a cornerstone program of the IAU International Year of Astronomy 2009. The workshop was organized by Associated Universities, Inc. (AUI) and the NRAO; University of California-Berkeley; Pontificia Universidad Católica de Chile; Museo Interactivo Mirador; Universidad de La Serena; and Gemini-CONICYT. It also benefited from the collaboration of EXPLORA and the United States Embassy in Chile.



(images/school\_clip\_image002.gif)

The attendees were from Chile and Brazil. The event was held at Pontificia Universidad Católica de Santiago, and the presentations were made via monitors from this university, Universidad de La Serena; and University of California-Berkeley. Carl Pennypacker, Rich Lohman and Stephanie Morgado from Berkeley brought material produced by Global Hands-On Universe, an educational initiative that promotes astronomical investigation by teachers and school students.



(images/school\_clip\_image004.gif)

Attendees were trained to use a range of astronomical tools designed to improve science teaching through creative use of images, software, virtual telescopes, web cameras, and interdisciplinary exercises and resources. This initiative will benefit about 4,000 scholars, providing clarity and methodologies for effectively teaching and learning astronomy.

The workshop program included: explanation of natural phenomena, such as eclipses and supernovae; teaching astronomical open-source software (SalsaJ and Stellarium); measuring digital images; calculating parallax angles; counting galaxies, and visiting the Santa Martina Observatory from Pontificia Universidad Católica de Chile.

To learn more about GTTP and Global Hands-On Universe programs, visit [www.site.galileoteachers.org](http://www.site.galileoteachers.org) (<http://www.site.galileoteachers.org/>) and [www.globalhou.net](http://www.globalhou.net) (<http://www.globalhou.net/>).

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## Recent Press Releases



### **Surprise: Dwarf Galaxy Harbors Supermassive Black Hole** **(<http://www.nrao.edu/pr/2011/bhdwarf/>)** **9 January 2011**

The surprising discovery of a supermassive black hole in a small nearby galaxy has given astronomers a tantalizing look at how black holes and galaxies may have grown in the early history of the Universe. Finding a black hole a million times more massive than the Sun in a star-forming dwarf galaxy is a strong indication that supermassive black holes formed before the buildup of galaxies, the astronomers said. **[Read more...](http://www.nrao.edu/pr/2011/bhdwarf/)** (<http://www.nrao.edu/pr/2011/bhdwarf/>)



### **Students Excited by Stellar Discovery** **(<http://www.nrao.edu/pr/2011/studentpulsar/>)** **2 February 2011**

In the constellation of Ophiuchus, above the disk of our Milky Way Galaxy, there lurks a stellar corpse spinning 30 times per second -- an exotic star known as a radio pulsar. This object was unknown until it was discovered last week by three high school students. These students are part of the Pulsar Search Collaboratory (PSC) project, run by the National Radio Astronomy Observatory (NRAO) in Green Bank, WV, and West Virginia University (WVU). **[Read more...](http://www.nrao.edu/pr/2011/studentpulsar/)** (<http://www.nrao.edu/pr/2011/studentpulsar/>)

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## From the Archives

Ellen Bouton

**([images/archives.png](#))**



***About this month's photograph:*** Anyone who observed in Green Bank from the mid-1960s through the 1980s was familiar with the shuttle. Every morning, 365 days a year for many years, vehicles left both Green Bank and Charlottesville and met in the parking area off U.S. Rt. 250 at the top of Shenandoah Mountain in the George Washington National Forest. The drivers traded the vehicles with their passengers/cargo and then returned to their office of origin. People (visitors and NRAO staff), equipment, data tapes, interoffice mail, and supplies: all traveled between Green Bank and Charlottesville on the shuttle. In this November 1977 photo, long-time drivers Merle Kerr (Green Bank) and James Garland (Charlottesville) and

their vehicles are at the Shenandoah Mountain exchange point.

*From the Archives* is an ongoing series illustrating NRAO and U.S. radio astronomy history via images selected from our collections of individuals' and institutional papers. If readers have images they believe would be of interest to the Archives, please contact Ellen Bouton, [ebouton@nrao.edu](mailto:ebouton@nrao.edu) (<mailto:ebouton@nrao.edu>).

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## Career Opportunities

### New Postings

**ALMA Project Manager** (<https://careers.nrao.edu/applicants/Central?quickFind=50621>): The Joint ALMA Observatory (JAO) is seeking a Project Manager with outstanding management abilities for the construction of the international ALMA radio astronomy observatory in Santiago, Chile. The Project Manager is responsible for the overall direction and coordination of the ALMA construction and integration conducted by the JAO and the three (European, East Asian and North American) Executives, and for maintaining the integrity of the construction schedule, work breakdown structure, cost development and assignment of deliverables.

**Head of the ALMA Department of Engineering** (<https://careers.nrao.edu/applicants/Central?quickFind=50619>): The international ALMA radio astronomy observatory in Santiago, Chile is recruiting a senior engineering manager with extensive experience to lead its Department of Engineering, which is responsible for the assembly and integration and the engineering operation of the observatory. The Head of ADE will be responsible for the engineering and technical staff within the Joint ALMA Observatory (JAO) and for the work outcomes from those staff including Assembly, Integration and Verification activities, Systems Integration efforts, and the ongoing engineering operations of the array

**Assistant Director, New Mexico Operations** (<https://careers.nrao.edu/applicants/Central?quickFind=50610>): The National Radio Astronomy Observatory in Socorro, New Mexico is accepting applications for an Assistant Director of New Mexico Operations (AD-NM). The AD-NM is responsible for the overall planning, management, and direction of all activities associated with New Mexico Operations. The AD-NM will provide scientific leadership and set science-driven operational priorities for both the Expanded Very Large Array (EVLA) and Very Long Baseline Array (VLBA), within the context of Observatory-wide Science Operations (OSO).

**ALMA Program Manager and Deputy Program Manager** (<https://careers.nrao.edu/applicants/Central?quickFind=50606>): The Joint ALMA Observatory (JAO) located in Santiago, Chile invites applications for both the Manager and Deputy Manager positions in the Program Management Group. The Program Manager and Deputy Program Manager will be responsible for the day-to-day management of observation execution, tracking of the status of ALMA programs as well as data quality control and coordination of these activities with the three ALMA Regional Centers (ARCs) located in Europe, North America and East Asia.

**ALMA Operations Astronomer** (<https://careers.nrao.edu/applicants/Central?quickFind=50607>): The Joint ALMA Observatory (JAO) in Santiago, Chile is seeking a scientist to participate in the scheduling and execution of observations, execute and develop the calibration plan, be responsible for data quality assurance, track the progress of observing programs, support array reconfiguration activities, develop documentation and content web pages, conduct technical reviews of ALMA proposals, as well as testing software tools used for Science Operations while conducting astronomical research.

**Associate Director, Administration** (<https://careers.nrao.edu/applicants/Central?quickFind=50600>): The National Radio Astronomy Observatory in Charlottesville, VA is recruiting for a chief financial and administrative officer for the Observatory to be responsible for Observatory budgets, business administration and other Observatory support services. The ADA is also responsible for the management and oversight of the following administrative areas: Budgeting, Accounting, Procurement, Safety, Facilities Planning, Management Information Systems and the oversight and coordination of the site

Business Offices, and other service divisions as may be assigned.

**Test Scientist:** (<https://careers.nrao.edu/applicants/Central?quickFind=50624>) The Joint ALMA Observatory (JAO) in Santiago, Chile invites applications for a Test Scientist to join the System Integration Group of the ALMA Department of Engineering. The System Integration Group coordinates assembly and integration tasks, and performs system verification tests of the ALMA antennas. The successful candidate will be part of the team responsible for ensuring that appropriate testing is accomplished in order to verify that system requirements are met. This position is funded from the construction project and is budgeted to last through December 2013.

[Staff](#) | [Policies](#) | [Diversity](#)



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