NRAO eNews: September 2009 • Volume 2, Issue 9

2009 NRAO Charlottesville Summer Students.

Upcoming Events

Assembly, Gas Content and Star Formation History of Galaxies
September 21-24, 2009 | Charlottesville, VA

NRAO Proposal Deadline
October 1, 2009 | 5:00 PM EDT

Jansky Lecture
October 27, 2009 | Charlottesville, VA

SKA 2009 Science and Engineering Meeting
October 29-31, 2009 | Manchester, UK

Jansky Fellowship Application Deadline
November 2, 2009

NRAO Town Hall at the American Astronomical Society Meeting
January 5, 2010 | 6:30 - 8:30 PM | Washington, DC

Key Science Projects at the NRAO

Robert Dickman, Karen O'Neill and Fred K.Y. Lo

Beginning with the Observatory's October 1, 2009 deadline, proposals for time on the VLBA, the GBT and the EVLA will be considered for designation as "Key Science Projects." Key Science Projects should be those that have high science impact, addressing fundamental and forefront issues in astronomy and astrophysics. The Key Science Project status of a proposal will be based on its scientific ranking from the proposal review process, the recommendation by the Proposal Selection Committee (PSC), and the approval by the NRAO Director. (Any proposal involving ALMA will go through the International ALMA Proposal Review Process for the ALMA part of the request.)

Both regular and large proposals are eligible for Key Project status; there will be no strict *a priori* limit to the amount of time that can be assigned to such projects, but up to 50% of the time at any particular LST is a practical starting point. Ongoing projects that have already been allocated time in previous trimesters may also be considered for Key Science Project designation. The progress of Key Science Projects that last over many years will be assessed annually, to assess their suitability for continued designation as Key Science Projects. The NRAO aims to provide maximum possible support to and to work collaboratively with the researchers of such Key Science Projects, so that the highest ranked projects are completed successfully and in a timely fashion.

To ensure optimum support within NRAO's resource limits, however, large programs receiving the Key Science designation are encouraged to consider sending students or postdoctoral fellows to be in residence at Socorro or Green Bank for a suitably extended period. Observatory staff will assist with training these individuals in VLBI and other techniques, and it is expected that these individuals will then play a significant role in assisting in the verification of project data quality and subsequent data processing and calibration.

In addition, the NRAO has a **program for supporting research by students at US universities and colleges**.

As a result of its ongoing VLBA bandwidth expansion program NRAO expects to be able to support 2 Gbps sustained data rates by the end of 2010. Scientifically justifiable requests for higher data rates will be considered. Such requests will be prioritized according to scientific merit and granted subject to the availability of media and correlator capacity. PIs may wish to contact NRAO staff ahead of time for help in determining media requirements for a particular project. PIs are also encouraged to consider providing additional media and/or correlator capacity, to enhance the overall VLBA capabilities for the entire VLBA user community.

NRAO Call for Proposals

Joan Wrobel and Toney Minter

The NRAO announces the Call for Proposals for trimester 10A. The call is open now and will close on **October 1, 2009 at 17:00 EDT (21:00 UTC).**

- **Details of the call for the Green Bank Telescope (GBT)** for observing from February 1, 2010 through May 31, 2010
- **Details of the call for the Expanded Very Large Array (EVLA) and the Very Long Baseline Array (VLBA)**
- **Observing periods and EVLA configurations** were announced in the August 2009 eNews

2010 Jansky Fellowship Program

Tim Bastian

The National Radio Astronomy Observatory (NRAO) announces the 2010 Jansky Fellowship program which provides outstanding opportunities for research in astronomy. Jansky Fellows formulate and carry out investigations either independently or in collaboration with others within the wide framework of interests of the Observatory. Prior radio experience is not required and multi-wavelength projects leading to a synergy with NRAO instruments are encouraged. The NRAO also encourages applications from candidates with interest in radio astronomy instrumentation, computation, and theory.

Appointments may be made for positions at any of these NRAO sites: Socorro, NM; Green Bank, WV; and Charlottesville, VA. As ALMA commissioning activities get underway, we anticipate that there will also be appointments available in Chile. Jansky Fellows are encouraged to spend time at universities working with collaborators during the course of their Fellowship.

In addition to appointments at NRAO sites, non-resident Jansky Fellowships may be offered for appointments that are hosted at a U.S. university. Frequent and/or long term visits to NRAO sites are encouraged. Split Fellowships with time spent at NRAO and a U.S. university are permitted.

The starting salary will be $60,000 per year with an appointment duration of two years, and possible renewal for a third. A research budget of up to $10,000 per year is provided for travel and computing requirements. Fellows are eligible for page charge support, vacation accrual, health insurance coverage, and a moving allowance. In addition, up to $3,000 per year is provided to non-NRAO institutions that are hosting Jansky Fellows to defray local institutional costs.

The NRAO web site provides further details on the **Jansky Fellowship Program and information on the application process**. Please note that candidates must receive their Ph.D. prior to beginning a Jansky Fellowship.

Approved Joint Chandra-NRAO Proposals for Cycle 11

Joan Wrobel and Toney Minter

Recognizing that radio observations using the NRAO facilities will be important to the scientific exploration by the Chandra X-ray Observatory, up to 3% of the total observing time on each NRAO telescope was made available for **joint observing**. Chandra Cycle 11 observing will begin in November 2009.

The following joint Chandra/NRAO proposals were approved for Cycle 11:

- Stephane Corbel, Centre d'Etudes de Saclay, **X-ray Jets in Microquasars**, 3 VLA hours
- Myriam Gitti, Smithsonian Astrophysical Observatory, **Investigating AGN Feedback in Cool Cores Detected in H-alpha**, 3 VLA hours
- Isabelle Grenier, Centre d'Etudes de Saclay, **ToO Observations of a Bright Transient Discovered by Fermi and Swift**, 1 VLA hour
- Kayhan Gultekin, University of Michigan, **COMBH: Chandra Observations of M-sigma Black Holes**, 12 VLA hours
- Peter Jonker, Smithsonian Astrophysical Observatory, **Following a Black Hole Candidate X-ray Transient to Quiescence**, 15 VLA hours

- Simon Migliari, European Space Agency, **Disk Wind and Jets in the Neutron Star Binary GX9+9**, 7 VLA hours
- Jon Miller, University of Michigan, **High Resolution Spectroscopy of a Black Hole Transient**, 4 VLA hours
- Jeremy Sanders, University of Cambridge, **Testing AGN Feedback with AWM7**, 4 VLA hours
- Gregory Sivakoff, University of Virginia, **Binary Formation in the Sparse Galactic Globular Cluster NGC 3021**, 1 GBT hour
- Ming Sun, University of Virginia, **Strong Shocks, Cavities and AGN Heating in Galaxy Groups**, 11 VLA hours

First Detection of the Zeeman Effect in the 36 GHz Methanol Maser Line with the EVLA

A. P. Sarma (DePaul Univ.) & E. Momjian (NRAO)

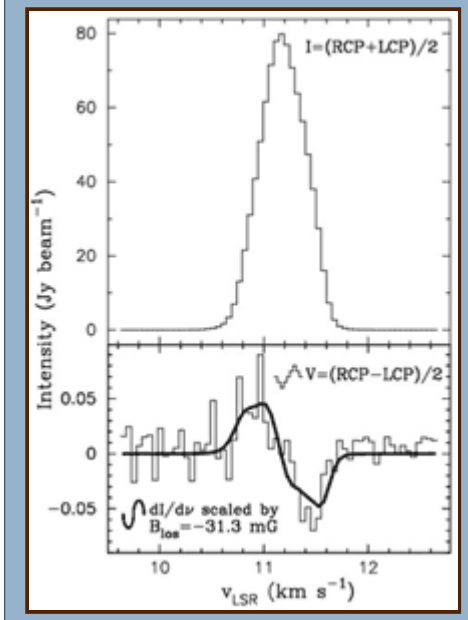


Fig. 1:— Stokes *I* (*top: histogram*) and *V* (*bottom: histogram*) profiles for the methanol maser in M8E. The curve superposed on *V* in the lower frame is the derivative of *I* scaled by a value of *B* = -31.3±3.5 mG.

We report the first detection of the Zeeman effect in the 36 GHz methanol maser line. The observations were carried out with 13 EVLA antennas toward the high-mass star-forming region M8E. The Zeeman effect is usually measured by fitting the Stokes V (the difference of the right and left circular polarizations) profile to the derivative of the Stokes I (total intensity) profile, and is shown in Fig. 1. The measured magnetic field toward this source is -31.3±3.5 mG.

The Zeeman effect is the most direct method for measuring magnetic field strengths. Magnetic fields likely play an important role in the star formation process, but the exact nature of their role is still not understood; this is primarily due to the scarcity of observational data. The 36 GHz

Class I methanol masers probe very early phases of star forming regions. M8E is known to be a high-mass star-forming region in a very early stage. The measured magnetic field in the 36 GHz Class I methanol maser is of the same order as the magnetic field in 6.7 GHz Class II methanol masers, for which a survey was carried out in 2008 by W. Vlemmings with the 100 m Effelsberg telescope. Class II masers also trace an early stage of star formation, but are believed to be closer to the protostellar source. The detection of the Zeeman effect in the 36 GHz methanol line by Sarma and Momjian opens up yet another window into the very early stages of a high-mass star-forming region.

EVLA Project Status

Mark McKinnon and EVLA Project Team

Antennas continue to be converted to the EVLA design. The conversion of the 23rd EVLA antenna was completed in August 2009, although a maximum of 22 EVLA antennas can be used with the VLA correlator. EVLA antennas accounted for 79.7% of all antenna hours used in scientific observations in July 2009.

A pinion gear in one of the two azimuth gearboxes in EVLA antenna 5 failed in April 2009. The EVLA antenna conversion schedule was interrupted to replace the antenna's gearbox and azimuth bearing. Although the replacement process caused a one month delay, the EVLA antenna conversions will still be complete in Q4 FY2010. A program was implemented to ascertain the extent of this problem in the other antennas. All antennas inspected to date show varying degrees of similar wear on their pinion gears, suggesting that the wear results from the method used to drive the antennas in azimuth. Once the inspections are complete in late 2009, we will develop a plan to repair the gearboxes in a prioritized fashion. Unless the gear wear is widespread and severe, we will make necessary gearbox repairs as part of the regular antenna overhauls beginning in FY2010.

The production and installation of fully EVLA-compliant receivers continues. To date, two L-band (1-2 GHz), four S-band (2-4 GHz), 12 C-band (4-8 GHz), and 13 Ka-band (26-40 GHz) receivers have been installed on antennas in the array. The "interim" versions of the L-band receiver are no longer being deployed. Detailed laboratory tests of an L-band receiver were conducted, and orders were placed for production L-band receiver components. The interim C-band receivers that have been used in the array for some time are being replaced by the fully EVLA-compliant versions. The prototype Ku-band (12-18 GHz) receiver was assembled and tested. The test results indicate that the receiver is exceeding performance specifications. Full production of the receiver should commence in late 2009.

Three different designs for the X-band (8-12 GHz) orthomode transducer (OMT) are being evaluated to optimize performance and to minimize cryogenic cooling requirements for the X-band receiver. A design for a turnstyle junction OMT was developed at the Central Development Laboratory. A planar-style OMT was built and tested in Green Bank. A quad-ridge style OMT with fins projecting from the OMT corners at 45 degree angles from the side walls is being built and tested in Socorro. In early October 2009, the performance characteristics of all three OMTs will be summarized and the final OMT selection will be made so that X-band receiver production can proceed on schedule.

Excellent progress continues with the production of feed horns for the EVLA. Nineteen S-band horns have been fabricated to date. This is on track for achieving the goal of having 20 horns completed by the end of the 2009 fiscal year. The production of Ku-band feed horns is underway at the Green Bank machine shop. The X-band feed horns are being fabricated by commercial machine shops. These horns should be completed well in advance of the X-band receiver production schedule. All other EVLA feed horns are complete.

The data transmission system of the EVLA employs a group of 3-bit, 4Gsps samplers to digitize the 8GHz of bandwidth per polarization from each EVLA antenna. The current sampler design employs a high speed digitizer followed by a de-multiplexer. The digitizer performs satisfactorily. The prototype de-multiplexer also performed satisfactorily; however, subsequent versions of the de-multiplexer have not met EVLA performance specifications. Further work on the current de-multiplexer design has been suspended, and alternative designs are being investigated. These alternatives fall within two general categories: (1) replacement with a de-multiplexer from a different vendor and (2) replication of the de-multiplexer within a fast floating point gate array (FPGA). The FPGA options tend to minimize cost impact and schedule delays. The technical evaluation of these options is underway. During a review in mid-October 2009, the options will be compared and a recommended path forward for the de-multiplexer design will be selected. The de-multiplexer issue will delay the availability of 8GHz observing capability with the EVLA for shared risk observing (SRO), but it is not expected to delay the completion of the EVLA project.

The production and installation of circuit boards for the WIDAR correlator is proceeding on schedule. The pre-production baseline boards were fabricated and successfully tested. After a successful NRC/NRAO production sign-off review on June 15, an order was placed to commence the full production of the final baseline boards. These boards should arrive in Penticton in September 2009, and their installation at the VLA site is scheduled for completion in March 2010. In early August 2009, 60 cross-bar boards and 54 station boards were delivered to the VLA site. The delivery and installation of all station boards should be complete by December 2009. The final correlator will contain 128 station boards, 128 baseline boards, and 64 cross-bar boards. To date, all 64 cross-bar boards, 24 station boards, and 10 baseline boards have been installed in the correlator racks.

Testing of this initial subset of the correlator, called WIDAR-0, continues. WIDAR-0 is currently capable of recording data from 12 EVLA antennas. In late July 2009, data were recorded in all four polarization products for the first time. Recent correlator testing has been complicated somewhat due to the increased complexity of systems integration issues with the additional circuit boards and the distribution of time code between them. We are making the systems integration effort more systematic so that correlator testing can be more efficient.

Software development for WIDAR continues with significant work and testing being done on the correlator configuration mapper. A non-real-time test version of the configuration mapper with a graphical user interface (GUI) was released. A cross-bar board GUI was also released. It allows for manual setting of the distributed cross-bar boards and full polarization (8-bit) testing. For the time being, this GUI will provide the method for establishing station-to-baseline switch connections.

A review of Science Support Systems (SSS) readiness for SRO was held on June 5. The review committee found that SSS is well positioned to support EVLA 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.

ALMA Construction

Al Wootten

At the 2900m elevation Operations Support Facility (OSF), interferometry continued between the two most recently accepted antennas, while the

first was readied for transport to the 5000m Array Operations Center (AOS) in mid-September. The first production Optical Pointing Telescope arrived and passed its acceptance tests. The second quadrant of the 64-antenna correlator arrived and was installed at the AOS Technical Building. With the installation of this quadrant, the 64 antenna correlator can process data from 32 antennas. A correlator to handle data from the 16 element Atacama Compact Array (ACA) was installed some time ago. Installation of electrical and fiber connections to the antenna pads is underway, in synchrony with the construction of the antenna access road network. The stations in the ACA area are complete except for connections; those are under way now.

Figure 1 In this panoramic time lapse view the AOS TB is in the distance at the right below Cerro Chajnantor; the ACA antenna stations lie in the foreground

The first antenna will be transported in mid-September to station 106 which is adjacent to the Technical Building. Here, the first high altitude tests of the antenna, the receiver, and the complete ALMA production system will begin. Several antennas will be stationed at the AOS and will be doing interferometric tests of the system by year's end.

Figure 2 Attendees at the review of the commissioning plans for ALMA visited the AOS on 1 September. In the Technical Building they inspected the second quadrant of the correlator, then undergoing provisional acceptance on-site. In this photo, l-r: L. Testi, P. Schilke, R. Rao, R. Wilson (back), R. Hills, M. Wright, A. Wootten, M. Wright, A. Saez.

A Review, chaired by R. Wilson (CfA), was held at the OSF on 2-3 September, covering the Commissioning and Science Verification plans for the array. Attendees were able to monitor interferometric tests between two antennas as well as total power tests of another antenna. In addition, participants were able to visit the site erection facilities of the antenna contractors, where more than a dozen other antennas are in various stages of construction and final testing.

VLBA to Begin Using the DiFX Software Correlator for Trimester 2010-A

Jon Romney, Claire Chandler, Walter Brisken, & Adam Deller

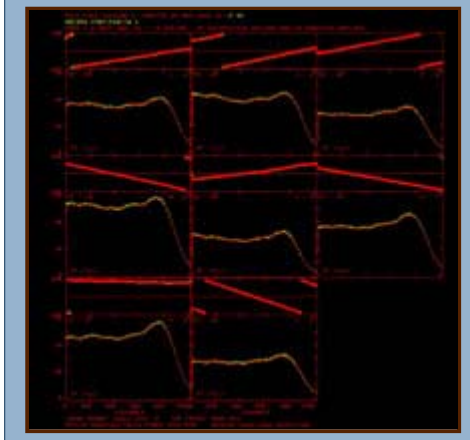


Figure 1

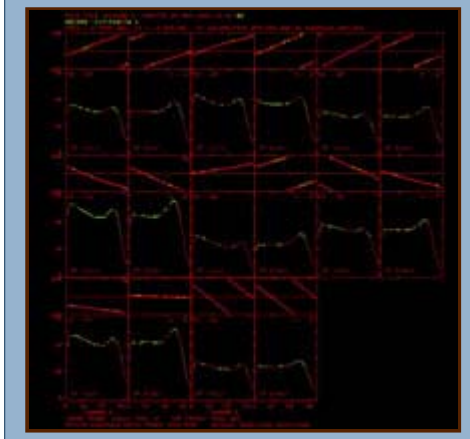


Figure 2

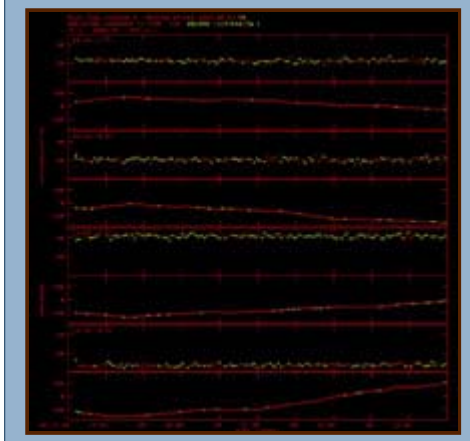


Figure 3

NRAO's implementation of the DiFX software correlator is the first element of the VLBA Sensitivity Upgrade project to be completed and, fortunately, it is one that can be put into operation, with scientific benefits to VLBA users, before the other elements are in place. DiFX was developed at Swinburne University in Melbourne, Australia, (Deller et al. 2007, PASP, 119, 318), and adapted to the VLBA operational environment by NRAO staff.

Ongoing point-by-point comparisons between DiFX and the original VLBA hardware correlator have yielded excellent results thus far. Amplitudes agree at better than (0.4 ± 1.7) percent, and phases to (0.1 ± 1.0) degrees, across a wide range of observing modes. The figures present a few test results, with the original correlator's output shown in yellow and DiFX in green. Overlaid points are red, in each case. Figs. 1 and 2 show amplitude and phase spectra for a subset of baselines, at high and low resolution, while Fig. 3 displays the variation with time of the amplitude and phase of the central spectral point in the spectra of Fig.2.

We therefore expect that all VLBA observations proposed at the 2009 October 1 deadline will be correlated using DiFX. In the near future, we also expect to announce opportunities for **rapid response "exploratory" proposals** to use DiFX later in Trimester 2009-C, and for requesting DiFX correlation of projects already granted observing time but not yet correlated.

An updated version of the VLBA Observational Status Summary, available concurrently with this announcement, provides current information on NRAO's implementation of DiFX. The principal new capabilities and other advantages DiFX offers at this time are summarized below.

- Spectral resolution as high as 4096 points per baseband channel, for any polarization configuration. Compared to the VLBA's original, hardware-based correlator, this is an increase by factors of 4 and 32, for parallel- and cross-hand polar processing. There is also no overall limitation across multiple baseband channels.
- Elimination of the current resolution limits in extreme narrow-band observations, which are imposed by the restricted sample decimation and fixed hardware cycle of the original correlator.

- Significantly shorter integration periods, in principle as short as twice the reciprocal frequency resolution.
- A substantially increased correlator output data rate limit of 10 Mbyte per second of observing time – a ten-fold increase (at speedup factor 1) over the most recent maximum rate available on the original VLBA hardware correlator.
- More sophisticated pulsar processing than the simple binary gate implemented in the original VLBA correlator.
- Correlation of any mix of VLBA, Mark4 and Mark5B formatted data.

The maxima specified above are flexible, and can be waived on the basis of a sufficiently compelling scientific justification.

Please consult the updated **VLBA Observational Status Summary** for detailed information. Most aspects of DiFX are discussed in Section 7, while the new pulsar gating options are presented in Section 16 on pulsar observations.

2009 NRAO Summer Student Research Program

Jeff Mangum

August brought to a close the 50th year of the NRAO Summer Student program. The student participants included undergraduate students, graduating seniors, and graduate students supported by various **NRAO student programs**. The 22 student projects are listed in the table.

Student	School	Project	Mentor(s)	Site
Crystal Anderson	New Mexico Institute of Mining and Technology	The Relationship Between Ionized Gas and X-Rays in a Massive Star Forming Region IRAS 20126	Debra Shepherd	Soc
Rogerio Cardoso	UW Madison	Disentangling AGN emission and star formation activity in deep radio continuum survey	Maurilio Pannella and Veronica Strazzullo	Soc
Kiruthika Devaraj	Georgia Institute of Technology	Radio Observations and Radiative Transfer Modeling of Planetary Atmospheres	Brigette Hesman	Soc
Kelley Liebst	University of Kansas	The Potential Effectiveness of the HI Stripping in Virgo	Aeree Chung	Soc
Joshua Marvil	New Mexico Tech	The properties of the radio continuum SEDs of nearby galaxies	Frazer Owen	Soc
Melissa Pastorius	DePaul University	Observations of Water Masers in High Mass Star Forming Regions with the VLA and VLBA	Emmanuel Momjian	Soc
Maxime Rischard	University of California, Berkeley	Millimeter study of AGN OJ287 during predicted maximum	Robert Dickman	Soc
Meagan White	University of Tennessee, Knoxville	Twenty years of observations of X-ray transient Aquila X-1	Amy Mioduszewski	Soc
Evan Kornacki	University of Texas at Austin	The Origin and Fate of Smiths Cloud	Jay Lockman	GB

Christine Mennicke	Concordia University, St. Paul	Observations of Pre-Biotic Chemistry	Glen Langston	GB
Shannon Ramey	West Virginia University	Characterization of the Accuracy and Stability of a High-Speed Analog to Digital Converter	John Ford	GB
Erica Whitfield	Southwest Baptist University	Numerical Precision Requirements of an All-Pass Digital Filter for Pulsar Applications	John Ford	GB
Kyle Woolard	University of Virginia	Observations of Pre-Biotic Chemistry	Glen Langston	GB
Katherine Wyman	Sonoma State University	Non-Radial Oscillations in Radio Pulsars	Rachel Rosen	GB
Bin Chen	University of Virginia	Studies of Solar and Interplanetary Radio Bursts	Tim Bastian	CV
Michael Lam	Colgate University	Exploring Systematic Effects in Millisecond Pulsar Timing	Paul Demorest	CV
Huilin Li	University of Virginia	Waveguide Flange Development for Terahertz Detector Technology	Tony Kerr	CV
Melissa Louie	Drew University	Searching for Jet-ISM Interactions Around X-ray Binary Systems	James Miller-Jones	CV
Patrick McCauley	James Madison University	Locating Star Formation Sites Using K-Doublet Formaldehyde Emission	Jeff Mangum	CV
Brian Roper	Virginia Polytechnic Institute and State University	Dissecting Luminous Starburst Galaxy Mergers	Aaron Evans	CV
Francillia Samuel	DePauw University	A Search for Water Maser Emission in the Early Universe	Violette Impellizzeri	CV
Jennifer Shitanishi	California State University Los Angeles	Magnetic Fields in Photo-Dissociation Regions	Dana Balser	CV

U.S. Committee on Radio Frequencies Visits ALMA

Sergio Cabezon

The U.S. Committee on Radio Frequencies (CORF).

The U.S. Committee on Radio Frequencies (CORF), a body of the National Academy of Sciences and National Research Council, visited the ALMA site in August escorted by NRAO personnel. This visit occurred as an adjunct to a CORF conference in Santiago, bringing together scientists, engineers, spectrum managers, and civil servants interested in the scientific use of the electromagnetic spectrum.

CORF protects the spectrum interests of astronomers, remote-sensing researchers, and other scientific users at radio frequencies. CORF also coordinates radio-frequency allocation and brings together representatives from space science, astronomy, atmospheric science, oceanography, life science, and remote sensing. Since radio emissions cross borders, CORF is cognizant of spectrum policy developments and activities domestically and internationally.

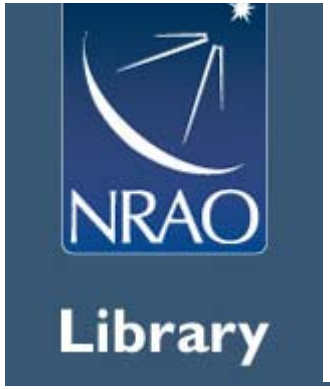
CORF organized this conference in Chile to stimulate contact with members of the regional scientific, engineering, spectrum management, and government communities. The conference featured exhibitions from SUBTEL (Subsecretaría de Telecomunicaciones de Chile); Associated Universities, Inc. and the National Radio Astronomy Observatory; the Joint ALMA Observatory; and others. CORF members presented the results of several committee reports, including the Survey of the Scientific Uses of the Spectrum, the Handbook of Frequency Allocations and Spectrum Protection for Scientific Uses, and public comments it has filed with the U.S. Federal Communications Commission. Members also presented findings from their own research.

After the conference, several CORF members were able to visit the ALMA site, including: Jeffrey Piepmeier (Chair, NASA Goddard Space Flight Center); Michael Davis (consultant); Melinda Piket-May (Univ of Colorado-Boulder); Steven Reising (Colorado State Univ); Donald Shapero (Board on Physics and Astronomy, and National Research Council); and David Lang (Program Officer and National Research Council).

Library Corner

Marsha Bishop

The NRAO Library has completed scanning the GBT Memos from 1 – 233. All GBT Memos are now available online.



We are working on the EDIR series and will continue until all NRAO Memos and Reports are available online.

Publication Support: When using an NRAO telescope, NRAO may provide publication support. For additional information, please see **Publication Support information and requirements**.

Have you received a request for Proposal Numbers (AKA Project Codes, Corresponding Project, Project ID, Legacy ID, etc.)? The NRAO Library is trying to collect all Proposal IDs (even we cannot decide what the correct name!) on current papers to not only link from papers to the original data, but to allow data mining by ADS, making available data more useful and more visible to scientists. We look forward to building a better system with your help.

Career Opportunities

New Postings

Scientists (NAASC): The North American ALMA Science Center (NAASC) seeks applicants with research interests in areas related to the goals of ALMA to join its User Support staff. They will provide advanced scientific and technical support to members of the North American ALMA community, and will have the opportunity to pursue a vigorous and independent research program. These positions will be filled at the assistant, associate, or scientist level, commensurate with experience.

NRAO Postdoctoral Fellow: The North American ALMA Science Center (NAASC) invites applications for a Postdoctoral Fellow to work with the NAASC scientific staff. The focus will primarily be on independent research, with an emphasis on exercising ALMA end-to-end software and databases from a scientific perspective, in particular the Splatalogue spectral line database.

Systems Engineer: The Atacama Large Millimeter Array (ALMA) is currently seeking a Systems Engineer at its headquarters in Charlottesville, Virginia, to work as part of the System Engineering team participating in equipment acceptance, planning system requirement verifications, maintaining system sensitivity, reviewing test results and populating those results to the available budget.

Jansky Fellowships: The 2010 Jansky Fellowship provides outstanding opportunities for research in astronomy. Jansky Fellows formulate and carry out investigations within the wide framework of the Observatory. Candidates with interest in radio astronomy instrumentation, computation, and theory are encouraged to apply.

Software Engineer II: The Software Development Division in Green Bank, WV is seeking a Software Engineer to help design, develop, implement, and support the Dynamic Scheduling System for the Green Bank Telescope. The Dynamic Scheduling System is broken into three major components: a web application built with the Django web development framework, a series of custom user interfaces built with Ext GWT,

and the core scheduler implemented in the functional programming language, Haskell. The Dynamic Scheduling team uses agile software development methods and automated unit testing to provide a working system for sponsors at every step of system development.

Software Engineer II (NAASC): ALMA seeks a software engineer to help evaluate, deploy, maintain, and write applications for the NAASC user portal and support the configuration and operation of the NRAO helpdesk. Will require constructively evaluating and leveraging existing NRAO web services and content, ALMA and NRAO prototypes, and new technologies.