National Radio Astronomy Observatory

Newsletter

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The NRAO Graphics Department will be happy to assist you in the production of images for your article as well as for your research papers. Contact Patricia Smiley (*psmiley@nrao.edu*) with your request.

If you have an interesting new research result obtained using NRAO telescopes that could be featured in the NRAO *Newsletter*, please contact Jim Condon at *jcondon@nrao.edu*. We particularly encourage Ph.D. students to describe their thesis work.

Editor: Mark T. Adams (*mtadams@nrao.edu*); Science Editor: Jim Condon (*jcondon@nrao.edu*);
Assistant Editor: Sheila Marks; Layout and Design: Patricia Smiley

Cover Image: More than 100 million years ago, the giant elliptical galaxy, NGC1316 (center of the image), began devouring its small northern neighbor. The complex radio emission, associated with this encounter (called Fornax A, shown in orange) was imaged using the Very Large Array in New Mexico. This image shows the radio emission superimposed on an optical image (STScI/POSS-II). The radio emission consists of two large radio lobes, each about 600,000 light years across.

Investigator(s): Ed Fomalont (NRAO), Ron Ekers (ATNF), Wil van Breugel and Kate Ebneter (UC-Berkeley)

Fred K. Y. Lo, Director

To operate three major facilities (VLA, VLBA, GBT) and, at the same time, undertake two major construction projects (ALMA and EVLA), the NRAO must have a strong and effective senior management team. Thus, it is a great pleasure to announce that after a careful and extensive search, Philip R. Jewell has accepted the position of NRAO Deputy Director. Phil assumed his Deputy Director duties effective June 20, 2005. As Deputy Director, Phil will oversee all of the Observatory's operations in New Mexico, West Virginia, and Virginia.

Phil comes to the Deputy Director position in Charlottesville having served as Site Director at Green Bank since 1999 where he did an exceptional job leading the West Virginia staff responsible for the Green Bank Telescope (GBT) development, operations, and maintenance. Prior to his arrival in Green Bank, Phil served the Observatory in several capacities, including Deputy Site Director in Tucson. Phil's management skills and intimate understanding of the Observatory's capabilities and culture will serve him well as Deputy Director.

Phil succeeds Jim Condon, who served as Interim Deputy Director for the past nine months. I would like to thank Jim for the outstanding job that he has done for me and for the Observatory. The Observatory faced major challenges during these months, and Jim has seen us through this period with remarkable skill, dedication, and calm.

It is also my pleasure to announce that Richard Prestage has agreed to serve as Interim Site Director for Green Bank when Phil Jewell assumes the Deputy Director position. Richard has been Phil's Deputy in Green Bank. He brings a wealth of experience and knowledge regarding the Green Bank staff and telescope to his new responsibilities. A search committee will be named in the near future to seek a permanent Green Bank Site Director.

George Clark has also recently joined the NRAO senior management team as Associate Director of Administration, arriving from the Institute for Astronomy at the University of Hawaii. At the NRAO, George is responsible for all the administration and business services of the Observatory, an important set of responsibilities.

Adrian Russell joined the NRAO as North American (NA) ALMA Project Manager in February 2005. His leadership has solidified the Observatory's improved management of the NA ALMA Project. Adrian has recently taken on additional responsibilities as North American Project Director for ALMA at the NRAO. He will have oversight responsibility for both the NA ALMA Project Office and the NA ALMA Science Center (NAASC) during the construction period. A search for a permanent head of the NAASC will be conducted soon as Paul Vanden Bout has indicated his intent to step down from this position by the end of 2005.

The senior management team also includes Peter Napier, who continues as Project Manager for the EVLA construction. Miller Goss, Head of the Division of Scientific and Academic Affairs (DSAA), oversees the scientific and academic programs of the Observatory. David Hubbard, as Head of Program Management Office (PMO), is responsible for reviewing programmatic status and future planning across the entire Observatory. Perhaps most importantly, Jim Ulvestad and Richard Prestage are at the front-lines ensuring that the VLA/EVLA, VLBA, and GBT facilities are optimized for astronomical research for the international astronomical community.

The Observatory's senior staff has been preparing intensively for the Senior Review of the National Science Foundation (NSF) - Astronomy Division portfolio. The goal of this Senior Review is to free up $30M of annual funding within the division by 2011 that will be distributed to the design and development of future projects such as the Giant Segmented Mirror Telescope (GSMT), the Large Synoptic Survey Telescope (LSST), the Square Kilometer Array (SKA), and ALMA operations. By July 31, 2005, NRAO, NOAO, NSO, NAIC, and Gemini have been directed to supply to the NSF the case, priority, and the defensible cost for their facilities, as well as the cost and timescale associated with potential closure of each of the component facilities. Guided by the Senior Review, the NSF will make decisions regarding the selective reduction of current facilities in order to start new initiatives. Community involvement is absolutely crucial, especially given the fast-track decision timescale required by the NSF. It is important for everyone affected by these decisions to carefully consider whether the proposed changes are viable and lead to a vital and sustainable future, or whether the proposed pace and scope are too drastic.

The NRAO senior staff is actively seeking input from the astronomical community and has been critically examining every aspect of our current operations in West Virginia, Virginia, and New Mexico. The Observatory's scientists, engineers, technicians, managers, and administrators have proposed and are actively considering a wide range of innovative options to enhance NRAO's scientific productivity and cost effectiveness, including seeking funding from sources outside the National Science Foundation. Regardless of the proposals and decisions that emerge from this comprehensive internal review process and the NSF Senior Review, the NRAO will remain dedicated to and focused on its primary mission: providing world-class, front-line research facilities that enable truly transformational science for the astronomical community.

K. Y. Lo

Riccardo Giacconi National Medal of Science Recipient

Riccardo Giacconi

Riccardo Giacconi, recently retired President of Associated Universities, Inc. (AUI), was awarded the National Medal of Science by President George W. Bush on March 14, 2005.

Giacconi, who received the Nobel Prize for Physics in 2002, was honored for his pioneering research in X-ray astronomy and for his visionary leadership of major astronomy facilities.

Established by Congress in 1959, the National Medal of Science is the Nation's highest honor for American scientists and is awarded annually by the President of the United States to individuals "deserving of special recognition for their outstanding contributions to knowledge."

"We are extremely proud that Riccardo Giacconi has been selected to receive the nation's highest award for scientific achievement," said current AUI President Ethan J. Schreier, a long-term colleague of Dr. Giacconi. "It is another fitting recognition for an outstanding scientific career that has enhanced our basic understanding of the universe," Schreier added.

Giacconi, known as the father of X-ray astronomy, used X-ray detectors launched on rockets to discover the first cosmic X-ray source in 1962. Because X-ray radiation is absorbed in Earth's atmosphere, space-based instruments are necessary to study it. Giacconi outlined a methodical program to investigate this new X-ray universe and, working with his research group at American Science and Engineering, Inc. in Cambridge, Massachusetts, developed the first space satellite dedicated to the new field of X-ray astronomy. Named Uhuru, this X-ray satellite observatory was launched in 1970 and subsequently discovered hundreds of X-ray sources. The ground-breaking work of Giacconi and his group led to the discovery of black holes, which to that point had been hypothesized but never seen. Giacconi was also the first to prove that the universe contains background radiation of X-ray light.

Riccardo Giacconi has played a key role in many other landmark astronomy programs. He was the Principal Investigator for the Einstein Observatory, the first imaging X-ray observatory, and led the team that proposed the current Chandra X-ray Observatory. He became the first director of the Space Telescope Science Institute, responsible for conducting the science program of the Hubble Space Telescope. He later moved to Germany to become Director-General of the European Southern Observatory (ESO), building the Very Large Telescope, an array of four 8-meter telescopes in Chile. While Director-General of ESO, Giacconi initiated a new cooperative program between the United States, ESO, and Canada to develop and build a large array of antennas for radio astronomy, the Atacama Large Millimeter Array (ALMA), in northern Chile.

Giacconi was President of AUI from 1999 to 2004. During his tenure, Giacconi's scientific vision dramatically advanced the observatory's capabilities. NRAO began the construction of ALMA in Chile and also the Expansion of the Very Large Array in New Mexico, opening new scientific frontiers across the entire radio spectrum.

"I am delighted that Riccardo Giacconi has received this recognition," said NRAO Director Fred K.Y. Lo. "The value and impact of the multi-wavelength astronomy which he enabled has been nothing short of revolutionary. This honor recognizes Giacconi's contributions to astronomy and the broader scientific community."

Dr. Giacconi is currently a University Professor at Johns Hopkins University in Baltimore, and remains a Distinguished Advisor to the Trustees of Associated Universities, Inc.

American Astronomical Society Honors Eric Greisen

Eric Greisen

The American Astronomical Society (AAS) has awarded its prestigious George Van Biesbroeck Prize to Dr. Eric Greisen of the National Radio Astronomy Observatory (NRAO) in Socorro, New Mexico. The society cited Greisen's quarter-century as "principal architect and tireless custodian" of the Astronomical Image Processing System (AIPS), a massive software package used by astronomers around the world, as "an invaluable service to astronomy."

The Van Biesbroeck Prize "honors a living individual for long-term extraordinary or unselfish service to astronomy, often beyond the requirements of his or her paid position." The AAS, with about 7,000 members, is the major organization of professional astronomers in North America.

Greisen, who received a Ph.D in astronomy from the California Institute of Technology, joined the NRAO in 1972. He moved from the observatory's headquarters in Charlottesville, Virginia, to its Array Operations Center in Socorro in 2000.

Greisen, who learned of the award in a telephone call from the AAS President, Dr. Robert Kirschner of Harvard University, said, "I'm pleased for the recognition of AIPS and also for the recognition of the contributions of radio astronomy to astronomy as a whole." He added that "it wasn't just me who did AIPS. There were many others."

The AIPS software package grew out of the need for an efficient tool for producing images with the VLA, which was being built in the late 1970s. Work on the package began in 1978 in Charlottesville. Now including nearly a million lines of program code and almost a half-million lines of documentation, AIPS is used at more than 500 sites around the world. The package is a mainstay and a daily tool for most of the world's radio astronomers, and also has been used by scientists in such other fields as fluid-dynamics simulation and medical imaging.

Over the years, Greisen and his colleagues at the NRAO have revised the AIPS package numerous times and expanded its capabilities as new astronomical and computing hardware was developed. The software has been kept independent of specific computing hardware and operating systems, and so has been successfully used on a wide variety of computing equipment.

“We are extremely proud of Eric’s work and congratulate him on receiving this award,” said NRAO Director Fred K.Y. Lo. “He has shown extraordinary dedication to making AIPS a valuable and effective tool for the world astronomical community, and this award is well-deserved recognition.”

Christopher Carilli Wins Max-Planck Research Award

Dr. Christopher Carilli, a National Radio Astronomy Observatory (NRAO) astronomer in Socorro, New Mexico, has been chosen to receive the prestigious Max Planck Research Award from the Alexander von Humboldt Foundation and the Max Planck Society in Germany.

Carilli, a radio astronomer, and German particle physicist Christof Wetterich are the 2005 recipients of the award, conferred on “one researcher working in Germany and one working abroad who have already gained an international reputation and who are expected to produce outstanding achievements in the framework of international collaboration,” according to an announcement from the Humboldt Foundation. “This is a great honor for Chris, and we are proud to see him receive such important international recognition for the excellence of his research,” said NRAO Director Fred K.Y. Lo.

Christopher Carilli

Carilli’s research has focused on studying very distant galaxies in the early Universe, and a quest to find the first luminous objects, such as stars or galaxies, to emerge. His most recent interests focus on unveiling the mysteries of what cosmologists call the “Epoch of Reionization,” when the first stars and galaxies ionized the neutral hydrogen that pervaded the young Universe.

Carilli and his research colleagues have used NRAO’s Very Large Array and other radio telescopes to discover that the molecular raw material for star formation already was present in a galaxy seen as it was about 800 million years after the Big Bang, less than 1/16 the current age of the Universe.

Carilli received a B.A. in Physics and Astronomy from the University of Pennsylvania and, in 1989, a Ph.D. in Physics from the Massachusetts Institute of Technology. After serving in research positions at the NRAO in Socorro, the Harvard-Smithsonian Center for Astrophysics, and Leiden Observatory in the Netherlands, Carilli joined NRAO’s permanent scientific staff in 1996. He also was a visiting Humboldt fellow in Bonn in 1999. He serves on a number of scientific advisory committees, and recently was chair of the international science advisory committee for the Square Kilometer Array project. He has co-edited five books and authored numerous research papers in a wide variety of scientific journals.

Science

The Wind-Wind Collision in WR140—Defining an Orbit with the VLBA

Massive binary systems containing a Wolf-Rayet star and an O-type star often exhibit synchrotron emission (Dougherty & Williams 2000) from relativistic electrons widely thought to be accelerated by diffusive shock acceleration (DSA). Observations with high spatial resolution reveal that the acceleration occurs where the stellar winds from the two stars collide—the wind-collision region (WCR). Such colliding-wind binary (CWB) systems present unique laboratories for investigating the underlying physics of DSA since they have higher mass, radiation, and magnetic-field energy densities than the supernova remnants that have historically been used for such work.

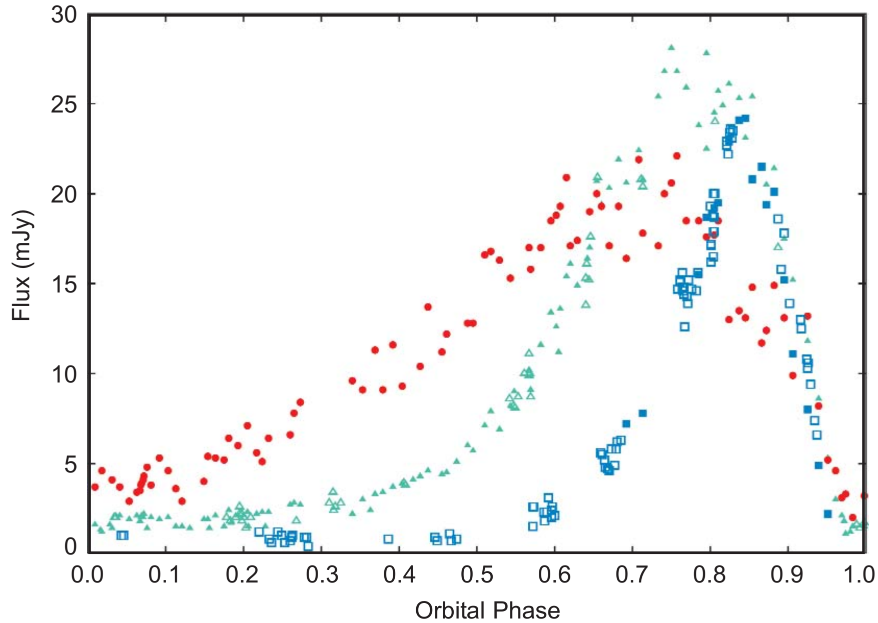

Figure 1. The radio emission from WR 140 as a function of orbital phase at 15 GHz (red), 5 GHz (green), and 1.5 GHz (blue) as measured with the VLA (solid symbols) and WSRT (open symbols) during the orbital cycle between 1984.3 and 1992.2. Data taken from Williams et al. (1990;1994) and White & Becker (1995).

The archetype of CWB systems is WR 140, a WR+O binary consisting of a WC7 star and an O4-5 star in a highly eccentric orbit ($e \approx 0.88$). This system is well known for the dramatic variations in its emission, from X-ray energies to radio wavelengths, which are clearly modulated by the 7.9-year orbit (see Figure 1). These variations are linked to the WCR, which experiences significant changes as the stellar separation varies between ~2 AU and ~30 AU.

The variations in the radio emission could result from a number of factors. The most widely discussed possibility is the changing free-free opacity through the stellar wind envelopes to the WCR as the orbit progresses (e.g. Williams et al. 1990; White & Becker 1995). To date, attempts to model the free-free opacity have failed to match the observed radio variations. One of the issues facing these models has been the unknown orientation of the binary orbit relative to the line-of-sight.

Many of the orbital parameters in WR 140 are well established, such as the period, eccentricity, and argument of periastron (see Marchenko et al. 2003). However, the orbital inclination (i), semi-major axis (a), and the longitude of the ascending node (Ω) require the system to be resolved into a "visual" binary. This has been achieved with the Infra-red Optical Telescope Array (IOTA) (Monnier et al. 2004), providing families of solutions for (i, a, Ω). High-resolution radio observations of the WCR with the Very Long Baseline Array (VLBA) remain the *only* means to determine the orbit direction and constrain i, and hence Ω and a.

Throughout 1999 and 2000, 8.4 GHz VLBA observations of WR 140 were made at 23 epochs spanning orbital phases 0.75 to 0.97. Images from three epochs are shown in Figure 2. The emission detected by the VLBA is clearly resolved into a bow-shaped or linear ridge of emission at each epoch, which appears to rotate from "pointing" NW to W over the observed orbital

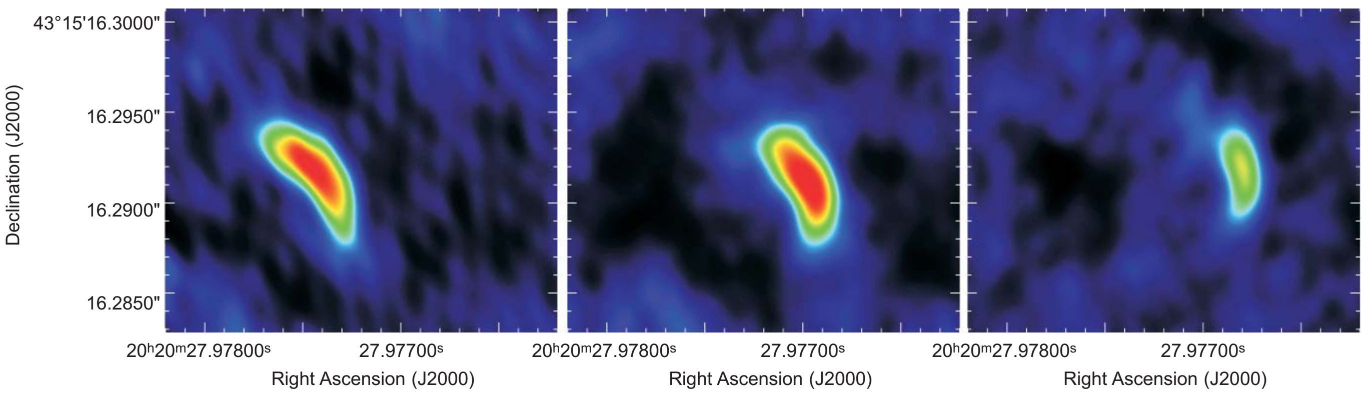

Figure 2. VLBA 8.4-GHz images of WR140 at orbital phases 0.74, 0.86, and 0.93. North is up and west is to the right. The rotation and proper motion of the WCR are clear. Movie files of all 23 epochs of observation of the system can be found at http://www.nrao.edu/pr/2005/wr140/.

phases. This rotation is the key to unraveling the orbital motion of WR 140.

If we assume that the arc of emission is symmetric about the line-of-centers connecting the two stars and points toward the WR star, the O star moves from SE of the WCR at epoch 0.74 to approximately E at phase 0.94. Using a χ^2 measure to fit the position angle of the line-of-centers deduced from orbits based on different sets of (i, Ω) to the observed change in the VLBA images as a function of orbit phase, we find $i = 122° \pm 5°$ and $\Omega = 353° \pm 3°$. These values lead to a semi-major axis of $a = 9.0 \pm 0.5$ mas.

Having determined the orbital inclination and semi-major axis, we can determine the distance to WR 140 *independent* of any stellar parameters. Marchenko et al. (2003) obtained $a \sin i = 14.10 \pm 0.54$ AU from radial velocity observations, which leads to $a = 16.6 \pm 1.1$ AU for $i = 122° \pm 5°$. We have derived the semi-major axis to be $a = 9.0 \pm 0.5$ mas, and together these estimates give a distance of 1.85 ± 0.16 kpc. This has many implications for the basic system parameters of WR 140, particularly the luminosity class of the O star which we find to be a supergiant rather than a dwarf as previously assumed, along with a commensurate rise in mass-loss rate. As a result, we find that the momentum ratio of the two stellar winds is 0.22, which permits us to position the stellar components relative to the WCR (see Figure 3).

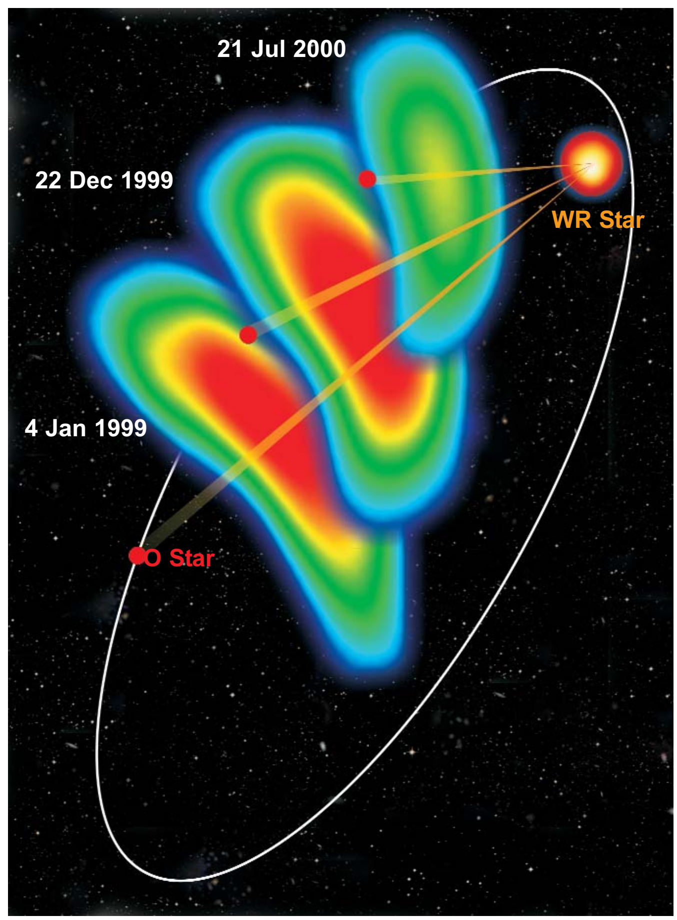

Figure 3. The VLBA observations from Fig. 2 overlaid on the deduced orbit of WR 140, with $e = 0.88$, $\omega = 47°$, $\Omega = 353°$, $i = 122°$ and $a = 9.0$ mas. The positions of the O star at phases 0.74, 0.87 and 0.94 are shown. Note the rotation of the position angle of the line-of-centers as the orbit progresses.

With the orbit fully defined, new radiative transfer models of colliding-wind systems based on self-consistent hydrodynamical models of the WCR (Dougherty et al. 2003; Pittard et al. 2005) will allow us to identify the essential absorption and cooling processes governing the observed emission from WR 140 and ultimately gain further insight into the DSA process.

For further information on the work see Dougherty et al. (2005).

S. M. Dougherty (NRC), A. J. Beasley (NRAO), M. J. Claussen (NRAO), B. A. Zauderer (U. Md.), and N. Bolingbroke (U. Victoria)

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A New Bursting Radio Source Toward the Galactic Center

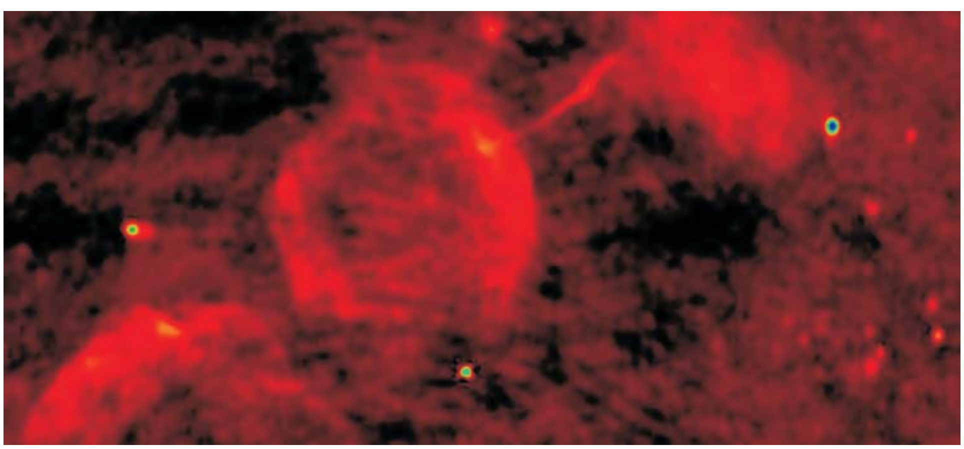

Figure 1. This 2002 VLA image shows the bursting transient radio source GCRT J1745-3009 as a green spot at the bottom center, approximately one degree south of the Galactic center. The supernova remnant SNR G359.1-0.5 is the ring just north of the transient.

The unique properties of the new bursting and transient radio source GCRT J1745-3009 suggest that a new class of astronomical objects has been discovered (Hyman et al. 2005). The radio source was detected in a 0.33 GHz observation toward the Galactic center made with the Very Large Array (VLA) in 2002. The source, shown in Figure 1, is located near the direction of the supernova remnant SNR G359.1-0.5, approximately 1.25 degrees south of the Galactic center.

Although variability is known for many kinds of radio sources (e.g., jets from black holes, pulsars, and flare stars), the variability exhibited by the new radio transient is more reminiscent of X-ray and γ-ray episodic outburst activity on timescales of minutes or hours to weeks, including violent bursting behavior. The radio sky has often been considered a relatively quiescent place. In contrast, GCRT J1745-3009 exhibits at least three timescales over the range from minutes to days to months. While some radio searches have been conducted for transient and variable sources (notably Gregory & Taylor 1981, 1986), wide-field radio surveys of the sky have been rare; and, with the exception of radio pulsars, most variable radio sources have been found as a result of following up X-ray transients and γ-ray bursts.

Recently, new radio telescopes and receivers combined with advances in wide-field imaging techniques, particularly at low frequencies (LaRosa et al. 2000; Nord et al. 2004), have allowed larger regions of the sky to be monitored in the radio. Over the last several years, we carried out a wide-field (~2.5°) monitoring program with the VLA at 0.33 GHz to discover new radio transients and to determine if classes of sources can be uncovered that are distinct from X-ray-selected transients. We concentrated the observations near the Galactic center because of the high density of sources in that region of sky. This approach led to the discoveries of the radio-selected transients GCRT J1746-2757 in 1998 (Hyman et al. 2002) and the bursting transient GCRT J1745-3009 in 2002. Currently, several new wide-field low-frequency radio telescopes are under development, including, for example, the Long-Wavelength Array (LWA, *http://lwa.nrl.navy.mil*). These will usher in a new era of sensitive monitoring on all timescales for new source classes over large areas of the sky.

Combining our monitoring observations with archival VLA observations, we have established temporal baseline measurements for ~250 sources and detected several transient candidates. The bursting transient GCRT J1745-3009 emitted a series of five bursts of strength ~1 Jy from September 30 to October 1, 2002, each burst lasting ~10 min. and successive bursts occurring at apparently regular intervals of 1.27 hr.

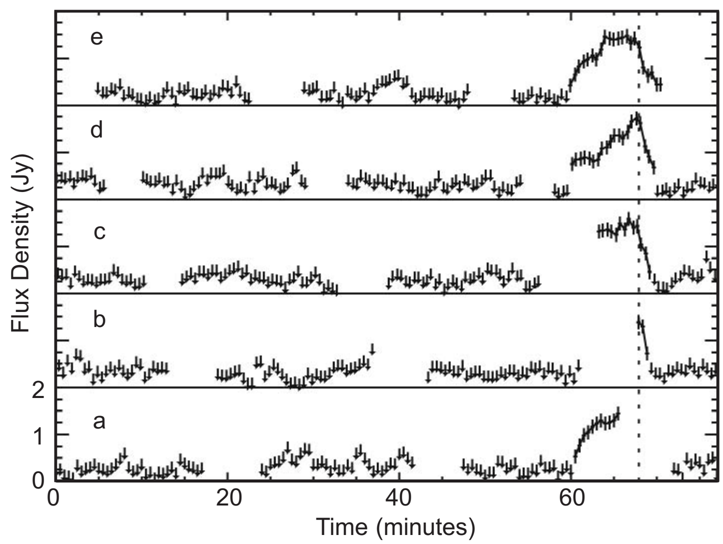

Figure 2. The five detected bursts from the radio transient source GCRT J1745-3009. The observation is continuous, with the time axis folded at multiples of 77.13 min. ***a. – e.*** *Successive intervals of the observation, beginning at 20:50:00 on September 30, 2002 (TAI). The points connected by the heavy line are the detections in 30-s samples with typical error bars of 0.15 Jy shown. The arrows are 3σ upper limits for nondetections between bursts; no evidence of quiescent emission is found. Note that several gaps in the data, including during the first three bursts, were caused by radio-frequency interference or time devoted to phase calibration. (Figure taken from Hyman et al. 2005).*

Figure 2 shows the light curve of the bursts. We found no definitive X-ray counterpart to GCRT J1745-3009 in the Rossi X-ray Timing Explorer All-Sky Monitor database, BeppoSAX archives, or the PCA Galactic Bulge scanning program.

The distance D to the source is not known, although it is more likely to be located near the Galactic center (D ~ 8.5 kpc) owing to the much higher density of sources there and the larger volume sampled in the radio beam. However, the ~1 Jy peak flux density and ~2 min decay time of GCRT J1745-3009 indicate that its brightness temperature exceeds the limit for incoherent synchrotron radiation if $D > 70$ pc, implying that the source is a coherent emitter. Known and suspected classes of coherent emission include pulsars, accreting binaries, flare stars, brown dwarfs, and exoplanets. These objects were considered by Hyman et al. (2005) but largely ruled out, leading to the conclusion that GCRT J1745-3009 is likely a member of a new source class.

We and Kent Wood of the Naval Research Laboratory are developing a model that attempts to account for the radio bursts as a new type of outburst from a magnetar, a compact object possessing an extremely high magnetic field. Additional detections are critical to constraining this and other models of the radio source's bursting and transient emission properties. Indeed, analysis of 0.33 GHz observations obtained with the Giant Metrewave Radio Telescope indicates the detection of additional bursting activity in 2003. This recurrence suggests that our ongoing investigation of GCRT J1745-3009 in the next few years could very well yield more detections leading to an understanding of its unique nature.

Scott Hyman (Sweet Briar College)
Namir Kassim, Joe Lazio, & Paul Ray
(Naval Research Laboratory)

Basic research in radio astronomy is supported at Sweet Briar College by funding from the Jeffress Memorial Trust and Research Corporation. Basic research in radio and X-ray astronomy is supported at the Naval Research Laboratory by the Office of Naval Research.

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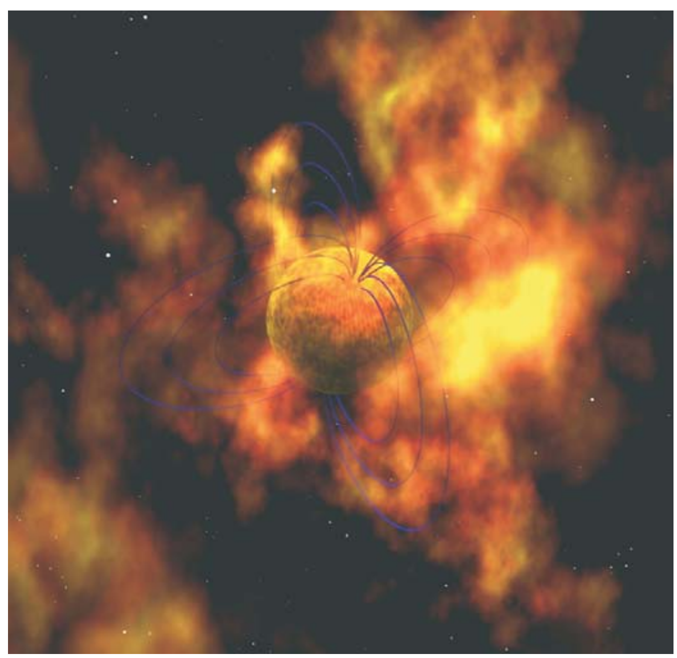
VLA Studies of a Giant High-Energy Flare from a Magnetar

On December 27, 2004 there was a brief flash of high-energy radiation that was the most intense transient yet observed. The flash was so bright that it disturbed the Earth's ionosphere and briefly saturated nearly every orbiting high-energy detector except those which received the signal as it bounced off the Moon.

What could cause such an event? Satellites quickly pinpointed this giant flare as coming from an object known as "soft gamma repeater" (SGR) 1806-20. SGRs are thought to be a rare class of hyper-magnetic neutron stars known as "magnetars" with field strengths of order 10^{15} Gauss, which produce recurrent bursts of soft gamma-rays. Occasionally, a large portion of this stored magnetic energy can be released in a catastrophic event during which the outer surface of the magnetar fractures and the magnetic fields reconnect in an extreme version of a solar flare.



Artist's conception of a magnetar (from http://antwrp.gsfc.nasa.gov/apod/ap980527.html).

Giant flares such as this have been seen from only two previous SGRs—the first from SGR 0526–66 on March 5, 1979 and another from SGR 1900+14 on August 27, 1998. All three giant flares had an initial spike of very high-energy radiation lasting a fraction of a second, followed by a fainter long pulsating tail of emission lasting hundreds of seconds. The pulsations following the SGR 1806-20 flare had a period of 7.56 seconds, the known rotational period of this neutron star (Hurley et al. 2005).

SGR 1806-20 is embedded in the Galactic Plane along a heavily obscured line of sight near the Galactic center (which has >30 magnitudes of optical extinction). In addition, at the time of the burst the SGR was only 5 degrees from the Sun, meaning optical and X-ray telescopes could not effectively or safely observe the source. Radio observations thus provided the sole avenue for studying the aftermath of the event.

Very Large Array (VLA) observations beginning seven days after the burst revealed a bright, resolved radio counterpart at the position of SGR 1806-20 (Cameron et al. 2005, Gaensler et al. 2005). This source was over 100 times brighter than the radio emission following the 1998 flare from SGR 1900+14, and it was observed to be expanding at mildly relativistic speeds (Gaensler et al. 2005). Early radio monitoring of the fading source has shown that the emission likely arises from material ejected from the neutron-star surface (Cameron et al. 2005). This is in contrast to the radio sources observed from cosmologically distant gamma-ray bursts, which involve the shocking of the circumstellar medium by highly relativistic ejecta, resulting in a radio “afterglow.” Thus the giant flare from SGR 1806-20 offers a unique opportunity to study the baryons from the neutron star surface directly.

Radio observations of the flare have also gave the first direct distance measurement to SGR 1806-20. A spectrum of the bright radio source centered on the 21-cm line of atomic hydrogen was used to probe the gas clouds along the line of sight. Intervening interstellar clouds appear as absorption features in this spectrum. These clouds are expected to participate in the rotation of the Galaxy, and the absorption features allow us to estimate “kinematic” distances. The spectrum shows that the distance to SGR 1806-20 is more than 6.4 kiloparsecs (kpc) and likely less than 10 kpc (Cameron et al. 2005). This is smaller than previous (indirect) measurements which placed SGR 1806-20 at distance of 15 kpc (Corbel & Eikenberry 2004). If correct, the lower distance results in a reduced energy for this event and a lower rate of such flares in nearby galaxies.

Radio monitoring with the VLA has continued to improve our understanding of the flare. The radio source began to brighten roughly twenty-five days after the flare. This rebrightening has been interpreted as a transition from the coasting expansion phase to an adiabatic cooling (Sedov-Taylor) phase (Gelfand et al. 2005). From this observation Gelfand et al. estimated that as much as 0.3 percent of the star’s volume was ejected during the giant flare. Precise measurements of the size of the radio source have confirmed that the expansion of the radio source slowed around this time, and they also suggest that the flare originated mainly from one side of the magnetar (Taylor et al. 2005). The VLA continues to follow this radio source to improve our understanding of the burst energetics.

P. B. Cameron (Caltech)

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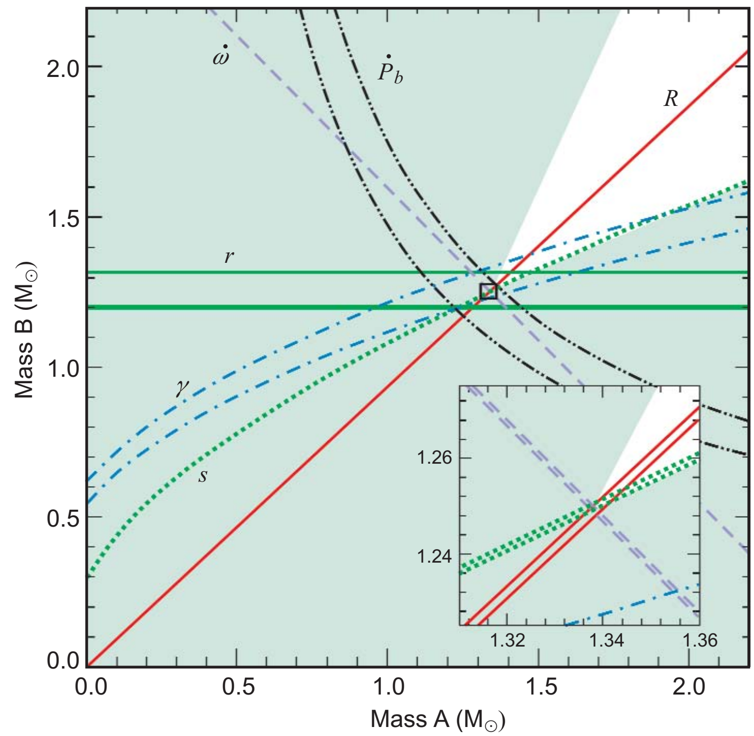
GBT Observations of the Double Pulsar Test Einstein's Theory of Gravitation

It seems very appropriate that in this World Year of Physics, celebrating also the 100th anniversary of Albert Einstein's "Wunderjahr," observations at the GBT have been crucial in providing the most stringent test yet of Einstein's theory of general relativity (GR) using the first known double-pulsar system.

The double pulsar was discovered in 2003 by our international team of British, Italian, Australian, Canadian, Indian, and U.S. scientists using the Parkes telescope in Australia. The 22.8 ms pulsar J0737-3039 (Burgay et al. 2003) was found to be a member of the most extreme relativistic binary system ever discovered: its short orbital period of only 2.4 hours is combined with a remarkably high value of orbital precession resulting in an advance of periastron of 16.9 degrees per year! A few months later, we also detected radio pulses from the second neutron star when data sets covering the full orbital period were analyzed (Lyne et al. 2004).

The reason why signals from the 2.8 s pulsar companion (now called PSR J0737-3039B) of the millisecond pulsar (now called PSR J0737-3039A) had not been noticed earlier is that B is only bright during two short parts of the orbit. For most of the orbit, pulsar B is extremely weak and only detectable with the most sensitive equipment—one reason why GBT observations are so important for studies of this unique system.



"Mass—mass" diagram summarizing observational constraints on the masses of the neutron stars in the double-pulsar system J0737-3039. Each PK parameter can be expressed by a unique relationship between the two masses of the system, predicted by GR or any other theory for each PK parameter, as a curve in the above diagram. We expect all curves, including that of the mass ratio R, to intersect in a single point if the chosen theory (here GR) is a valid description of this system. The shaded regions are those excluded by the Keplerian mass functions of the two pulsars. Further constraints are shown as pairs of lines enclosing permitted regions as given by the observed mass ratio and PK parameters shown here as predicted by GR. The inset is an enlarged view of the small square encompassing the intersection of these constraints (see text).

In addition to being a superb opportunity to understand the workings of a pulsar magnetosphere (e.g. McLaughlin et al. 2004 a,b), the double pulsar is a superb gravity lab. Tests of GR can be performed when a number of relativistic corrections to the Keplerian description of an orbit, the so-called "post-Keplerian" (PK) parameters, can be measured. As A has the faster pulse period we can time A much more accurately than B and measure precise PK parameters for A's orbit. In addition to the PK parameter for the periastron advance, a second PK-parameter γ denotes the amplitude of delays in arrival times caused by the varying effects of the gravitational redshift and time dilation as the pulsar moves in its elliptical orbit at varying distances from the companion and with varying speeds.

Two other PK parameters, r and s, are related to the "Shapiro delay" of A's pulses while propagating through the curved spacetime near B. While all these quantities have indeed been measured for A, the precise measurements of the orbits of both A and B open up opportunities that go well beyond what is possible with previously known double neutron stars.

From the projected semi-major axes of the orbits, we obtain a precise mass ratio from Kepler's third law: $M_A / M_B = x_B / x_A$. For every realistic theory of gravity, we expect the mass ratio to follow this simple relation, at least to so-called first post-Newtonian order. This provides a stringent and new constraint for tests of gravitational theories as any combination of masses derived from the PK-parameters must be consistent with this mass ratio. This additional constraint makes the double pulsar unique in both the quantity and quality of tests that are achievable.

As a result of sensitive GBT timing observations, the decay of the orbit due to gravitational-wave damping, expressed by a change in orbital period, has also been detected. The binary orbit shrinks due to gravitational-wave emission with a rate of 7mm/day (Kramer et al., in prep.)

As announced by team member Ingrid Stairs (UBC) at the summer 2005 AAS meeting in Minneapolis, our GBT observations also led to the detection of systematic pulse-shape changes in pulsar A. Indeed, profile changes on secular time scales are expected for both pulsars due to geodetic precession as predicted by GR. In a binary pulsar this geodetic precession leads to a relativistic spin-orbit coupling where the pulsar spins precess about the total angular momentum, changing the relative orientations of the pulsars to one another and toward Earth. The precession rates depend on the masses and the orbital parameters. GR predicts precession periods of only 75 yr for A and 71 yr for B—by far the shortest for any pulsar system. Geodetic precession also leads to a change in the relative alignment of the pulsar magnetospheres, so that geodetic precession may also explain changes in the visibility pattern of B that we recently found (Burgay et al. 2005).

From our observations, we derive pulsar masses of $M_A = 1.338 \pm 0.001\ M_\odot$ and $M_B = 1.249 \pm 0.001\ M_\odot$. Using these, we can compute the Shapiro delay parameter s as predicted by GR and compare it to the observed value. We find that $s_{GR} / s_{obs} = 1.0002\ ^{+0.0011}/_{-0.0006}$. Hence, GR passes this test at the 0.1 percent level. This is the most stringent test of GR in the strong-field limit so far.

In a few years, we should be able to measure new PK parameters. With the GBT we even expect a precision that would allow us to test the prediction by GR that, in contrast to Newtonian physics, the neutron stars' spins affect their orbital motion—an effect that should be visible as a tiny contribution to the observed periastron advance. If two parameters, e.g. the Shapiro parameter s and the mass ratio R, can be measured sufficiently accurately, we can compute the periastron advance expected without spin contributions. Comparing the result to the observed value, we may be able to isolate the spin contributions, giving access to a neutron star's moment of inertia for the first time. Even a rough measurement of this quantity can rule out several classes of "equation-of-state," and our understanding of matter at extreme pressures and densities can be tested.

With the measurement of five PK parameters and the unique information about the mass ratio, the PSR J0737-3039 system provides a truly unique test-bed for relativistic theories of gravity. So far, GR also passes this test with flying colors. However, this is only the beginning of a study of relativistic phenomena that can be investigated in great detail in this wonderful cosmic laboratory.

M. Kramer (Jodrell Bank)

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Atacama Large Millimeter Array

Figure 1. Construction of an expansion of the ALMA Camp, center of activity at the site, will be finished in early June. The expanded Camp will accommodate thirty persons. Expansion of the nearby Contractor's Camp, the local center for those working on construction of ALMA, will be finished within a few months.

Technical News

The ALMA 1.3 mm receiver (Band 6) has been integrated with the ALMA cryostat as part of the Prototype System Integration task currently underway. The receiver itself is integrated into a "cartridge assembly", a cylindrical structure into which the receiver, elements of the local oscillator and other electronics associated with a particular ALMA band are assembled. The individual cartridges are then mounted into the ALMA cryostat which lies in the antenna focal plane. The integration of cartridge and cryostat is a key task of the ALMA Front End Integration Center which is being built at the NRAO Technology Center in Charlottesville. In somewhat less than a year's time, several other cartridges will also be mounted in the cryostat, which will then be deployed on one of the prototype antennas at the ALMA Test Facility (ATF) at the Very Large Array site in New Mexico.

The first eight receivers in any ALMA Band are the pre-production receivers. Design improvements will result from the initial tests of cartridges incorporating these receivers before the final production run begins. The initial tests of the Band 6 receiver show that it is the most sensitive ever constructed. The receiver specification requires single-sideband receiver temperature below 83K over 80 percent of the band (211-275 GHz), and a receiver temperature less than 138 K over the remaining 20 percent of the band. The first Band 6 receiver performs substantially better than these specifications.

Sensitive receiver performance is a key element for reaching ALMA science goals. For example, one of the Design Reference Science Plan (DRSP) projects (1.1.1) (*http://www.strw.leidenuniv.nl/~alma/drsp.html)* proposes a medium-scale (4' × 4') deep survey of the IR background, and the population of dusty, star-forming galaxies at high redshift thought to provide the background radiation. A significant fraction (~50 percent) of star formation in the cosmos occurs in galaxies that are heavily obscured by dust; this fraction may rise with redshift, possibly corresponding to the formation of spheroidal galaxies in active starbursts. One highly uncertain aspect of the study of sub-millimeter galaxies is their redshift distribution. Optical redshifts remain problematic for the majority of such sources, and can be misleading due to possible mis-identifications.

With the ALMA sensitivity at 1.3 mm, the DRSP survey can identify several hundred sources in eighty hours of integration time to a detection limit 5-10 times more sensitive than continuum surveys made by large bolometer cameras (though the cameras will cover much wider fields of view they will be limited by their larger beamsize to a sensitivity limit such that adjacent sources blend into each other). ALMA will explore a range of star formation rates much lower than those of currently detected sub-mm sources. For example, at a proposed sensitivity level of 0.1 mJy, the survey should be able to find between 100 and 300 continuum sources, depending on the applicable cosmological model, with 30 to 90 sources brighter than 0.4 mJy.

A further phase of this proposed research investigates the molecular gas content of the same field of galaxies. The whole Band 6 frequency coverage can be covered in 8 tunings of the receivers. One could achieve a continuum sensitivity (averaged over the total 64 GHz) of 50 μJy at 5 σ all over the 4'× 4' field. Such a field requires about 90 pointings at each frequency tuning (70 at 210 GHz, 110 at 270 GHz). An integration time of two hours per pointing (all tunings included) is required to reach this sensitivity level, leading to a total time of eight days to perform the program.

The continuum part of this survey duplicates Part 1: all sources detected in Part 1 will be detected in the second. However, this part also allows detection of the CO lines from the sources. Because of the overlap, it is conceivable to perform this second part with some angular resolution. For this exercise, we assume an angular resolution of 0.4", already better than that of the best images obtained so far. The continuum brightness sensitivity corresponds to 1 mK (1 σ) at this angular resolution.

Statistics on the strength of the CO lines redshifted to such frequencies are still too scarce to predict a detection rate. The brightness sensitivity of the instrument is then 0.05 K (1 σ) for 50 km/s resolution. This is well below the typical line strength of CO in nearby galaxies. Even accounting for additional beam dilution, we would thus expect a large number of detections. The highest redshift objects may escape detection, since the high-J CO lines may not be significantly excited at the temperature of the emitting gas. However, at the expected sensitivities, one could perhaps start to detect species other than CO such as HCN, which is typically ten times weaker. For galaxies with $z>2$, multiple CO lines would fall within the spectral window.

Conducted as described above, the second part of the survey would allow one to obtain sizes of most of the sources detected in Part 1, as well as dynamical masses for the brighter objects. Lensing correction for the brightest sources may also be possible, as the angular resolution will help in building a first-order lens model for the brightest sources.

ALMA Board Meeting

The ALMA Board met in Pasadena, California during a series of meetings which included an ALMA Management Advisory Committee meeting. At this meeting, the Board approved Version A of the ALMA Operations Plan. The Board also heard a report from Jean Turner, Chairman of the ALMA Science Advisory Committee (ASAC), which had met 24 and 25 February in Garching, Germany. Discussions centered on a request by the ALMA Board to consider the scientific impact of options for rebaselining ALMA. Rebaselining is the process of adjusting the ALMA budget to account for changes over the years, and is driven in large part by large increases in commodity prices, particularly steel and oil. The resultant cost increases to ALMA must be accounted; options for realizing cost reductions were presented to the ASAC for discussion. The most sweeping change is to adjust the number of antennas. In the bilateral ALMA project, 64 antennas are specified to achieve the Level One science goals: Detection of a CO or [C II] transition in a galaxy of Milky Way luminosity at a redshift z=3 within a day's integration, imaging of a protoplanetary disk in the nearest molecular cloud to determine its structure and kinematics, and production of high dynamic range high-fidelity images. The effect on these science goals was discussed by the ASAC and a report was written in consultation with the ALMA North American Science Advisory Committee. This report was presented to the ALMA Board in April and is available at *http://www.alma.nrao.edu/committees/ASAC/asacreport_2005feb.pdf*. The report concludes that ALMA science is driven by sensitivity and image quality. Sensitivity, measured by integration time, varies as the square of the number of antennas. Image quality varies by the square of the number of baselines. The Board approved the ASAC recommendation that L. Testi succeed J. Turner as its Chairperson. C. Wilson will become Vice Chair.

H. A. Wootten

North American ALMA Science Center

An ALMA workshop is being planned to discuss the new suite of ultrawide bandwidth sub-millimeter spectrometers now under development for several telescopes. The main goals of such a workshop tentatively titled: *From Z to A: Z - Machines to ALMA* would be to familiarize the community with these instruments' capabilities, highlight the most important scientific questions about dusty high-redshift galaxies that they will be able to address in the near-term, and discuss how observing programs can be designed to optimize synergy with ALMA and the EVLA on longer timescales. This would be a small workshop (~60 participants) held in Charlottesville, Virginia following the January 2006 meeting of the American Astronomical Society (AAS) in Washington D.C. The ANASAC is spearheading this effort and a Scientific Organizing Committee has begun planning for the workshop.

H. A. Wootten

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VLBA Large Proposal Review

In May 2005, the NRAO convened a meeting of the VLA/VLBA Large Proposal Review Committee to consider new large VLBA proposals received at the October 2004 and February 2005 deadlines. This Committee consists entirely of scientists from outside the NRAO, who consider the broad scientific impact of large observing proposals in their deliberations. At their May meeting, the Committee was advised by the undersigned of the proposals' logistical impact on other observing, but otherwise acted independently in arriving at their recommendations. It is the intent of the NRAO to implement all the recommendations of the Committee.

Of the two VLBA proposals considered, one was accepted for all of its requested time and one was rejected. The successful proposal is entitled *The Spiral Structure and Kinematics of the Milky Way* (Mark Reid et al.), and it was allocated 270 hours spanning 1.5 years.

As announced in the April 2005 NRAO *Newsletter*, new large VLBA proposals will forthwith be reviewed on the same schedule as large VLA proposals, i.e., once every 16 months. The next deadline for large VLA/VLBA proposals will be in October, 2006.

J.M. Wrobel

VLA Configuration Schedule; VLA/VLBA Proposals

Configuration	Starting Date	Ending Date	Proposal Deadline
CnB	17 Jun 2005	05 Jul 2005	1 Feb 2005
C	08 Jul 2005	03 Oct 2005	1 Feb 2005
DnC	14 Oct 2005	31 Oct 2005	1 Jun 2005
D	04 Nov 2005	17 Jan 2006	1 Jun 2005
Large VLA/VLBA	03 Feb 2006	14 May 2007	1 Jun 2005
A(+PT?)	03 Feb 2006	15 May 2006	3 Oct 2005
BnA	26 May 2006	12 Jun 2006	1 Feb 2006
B	16 Jun 2006	18 Sep 2006	1 Feb 2006
CnB	29 Sep 2006	16 Oct 2006	1 Jun 2006
C	20 Oct 2006	16 Jan 2007	1 Jun 2006
DnC	26 Jan 2007	12 Feb 2007	2 Oct 2006
D	16 Feb 2007	14 May 2007	2 Oct 2006

GENERAL: Please use the most recent proposal coversheets, which can be retrieved at *http://www.nrao.edu/administration/directors_office/tel-vla.shtml* for the VLA and at *http://www.nrao.edu/administration/directors_office/vlba-gvlbi.shtml* for the VLBA. Proposals in Adobe Postscript format may be sent to *propsoc@nrao.edu*. Please ensure that the Postscript files request U.S. standard letter paper. Proposals may also be sent by U.S. mail, as described at the web addresses given above. FAX submissions will not be accepted. Finally, VLA/VLBA referee reports are now distributed to proposers by email only, so please provide current email addresses for all proposal authors via the most recent LaTeX proposal coversheets.

VLA: The maximum antenna separations for the four VLA configurations are A-36 km, B-11 km, C-3 km, and D-1 km. The BnA, CnB, and DnC configurations are the hybrid configurations with the long north arm, which produce a circular beam for sources south of about -15 degrees declination and for sources north of about 80 degree declination. Some types of VLA observations are significantly more difficult in daytime than at night. These include observations at 90 cm (solar and other interference; disturbed ionosphere, especially at dawn), deep 20 cm observations (solar interference), line observations at 18 and 21 cm (solar interference), polarization measurements at L band (uncertainty in ionospheric rotation measure), and observations at 2 cm and shorter wavelengths in B and A configurations (trophospheric phase variations, especially in summer). Proposers should defer such observations for a configuration cycle to avoid such problems. In 2005, the D configuration daytime will involve RAs between 14^h and 20^h. In 2006, the A configuration daytime will involve RAs between 21^h and 04^h. Current and past VLA schedules may be found at *http://www.vla.nrao.edu/astro/prop/schedules/old/*. EVLA construction will continue to impact VLA observers; please see the web page at: http://*www.aoc.nrao.edu/evla/archive/transition/impact.html*.

Approximate VLA Configuration Schedule

	Q1	Q2	Q3	Q4
2005	A,B	B,C	C	D
2006	A	A,B	B,C	C
2007	D	D,A	A	A,B

VLBA: Time will be allocated for the VLBA on intervals approximately corresponding to the VLA configurations, from those proposals in-hand at the corresponding VLA proposal deadline. VLBA proposals requesting antennas beyond the 10-element VLBA must quantitatively justify the benefits of the additional antennas. Any proposal requesting a non-VLBA antenna is ineligible for dynamic scheduling, and fixed-date scheduling of the VLBA currently amounts to only about one quarter of observing time. Adverse weather increases the scheduling prospects for dynamic proposals requesting frequencies below about 10 GHz. See *http://www.vlba.nrao.edu/astro/schedules/* for a list of dynamic programs which are currently in the queue or were recently observed. VLBA proposals requesting the GBT, the VLA, and/or Arecibo need to be sent only to the NRAO. Note also the possibility to propose for the High Sensitivity Array (discussed in previous *Newsletter* articles, e.g. Issue 99; also see *http://www.nrao.edu/HSA*. Any proposal requesting NRAO antennas and antennas from two or more institutions affiliated with the European VLBI Network (EVN) is a Global proposal, and must reach *both* the EVN scheduler and the NRAO on or before the proposal deadline. VLBA proposals requesting only one EVN antenna, or requesting unaffiliated antennas, are handled on a bilatteral basis; the proposal should be sent both to the NRAO and to the operating institution of the other antenna requested. Coordination of observations with non-NRAO antennas, other than members of the EVN and the DSN, is the responsibility of the proposer.

J. M. Wrobel and B. G. Clark
schedsoc@nrao.edu

VLBI Global Network Call for Proposals

Proposals for VLBI Global Network observing are handled by the NRAO. There are three Global Network sessions per year, with up to three weeks allowed per session. The Global Network sessions currently planned are:

Date	Proposals Due
20 Oct to 10 Nov 2005	01 Jun 2005
Feb/Mar 2006	01 Oct 2005

Any proposal requesting NRAO antennas and antennas from two or more institutions affiliated with the European VLBI Network (EVN) is a Global proposal, and must reach *both* the EVN scheduler and the NRAO on or before the proposal deadline. FAX submissions of Global proposals will not be accepted. A few EVN-only observations may be processed by the Socorro correlator if they require features of the EVN correlator at JIVE which are not yet implemented. Other proposals (not in EVN sessions) that request the use of the Socorro correlator must be sent to NRAO, even if they do not request the use of NRAO antennas. Similarly, proposals that request the use of the EVN correlator at JIVE must be sent to the EVN, even if they do not request the use of any EVN antennas. All requests for use of the Bonn correlator must be sent to the MPIfR.

Please use the most recent proposal coversheet, which can be retrieved at *http://www.nrao.edu/administration/directors_office/vlba-gvlbi.shtml*. Proposals may be submitted electronically in Adobe Postscript format. For Global proposals, those to the EVN alone, or those requiring the Bonn correlator, send proposals to *proposevn@hp.mpifr-bonn.mpg.de*. For Global proposals that include requests for NRAO resources, send proposals to *propsoc@nrao.edu*. Please ensure that the Postscript files sent to the latter address request U.S. standard letter paper.

Proposals may also be sent by paper mail, as described at the web address given. Only black-and-white reproductions of proposal figures will be forwarded to VLA/VLBA referees. Finally, VLA/VLBA referee reports are now distributed to proposers by email only, so please provide current email addresses for all proposal authors via the most recent LaTeX proposal coversheet.

J. M. Wrobel and B. G. Clark

Status of the VLBA's Transition to Mark 5 Recording

Initiation of the VLBA's transition to Mark 5 disk-based recording was reported in *Issue 102* of the NRAO *Newsletter*. This article is an update on continuing progress toward completion of that transition.

Six VLBA stations are now equipped for Mark 5 recording, and corresponding Mark 5 units have replaced six tape playbacks at the VLBA correlator. The new units include three provided by ESA, and three by NASA, in support of the Huygens probe's landing on Titan in January 2005. Our complement of Mark 5 disk modules has expanded to a total capacity exceeding 250 TB, equivalent to a six-station 30-day media pool at 128 Mbps mean recording rate. The cost of magnetic disk media had fallen to $0.54/GB as of our most recent procurement.

J. S. Ulvestad and J. D. Romney

A New Proposal System for NRAO Telescopes

The NRAO is developing a new Proposal Submission Tool (PST) which is intended to become the mechanism for submitting proposals for observing time at any of the NRAO telescopes. The PST is a web-based tool, which will allow scientists an easy way to prepare and submit their proposals.

To access the web proposal tool, proposers will need to first register a username and obtain a password. Both the principal investigator and the contact author must be registered users. On this registration form you will be asked contact information which will be used for notification about proposal status, telescope schedules, funding, etc. We encourage proposers to register early. The web proposal tool can be accessed from: *http://e2e.nrao.edu/userdb/.*

The initial release of the PST was in May 2005. For the June 1, 2005 deadline the PST was used to accept only Green Bank Telescope proposals. Pending a successful initial release at Green Bank, our intention is to deploy the PST at the VLA for the October 2005 deadline. Potential proposers will be notified in early September, via our standard email lists and the VLA web page, if the new PST will be utilized for VLA proposals at the October 2005 deadline. VLBA and Global VLBI proposals will be switched over to the PST at a later date.

Please email any about inquiries the status of this tool to *proposal@aoc.nrao.edu*.

D. A. Frail

[VLA+Pie Town] Link Observing in the 2006 A Configuration

The VLA+Pie Town fiber optic link, connecting the VLBA Pie Town antenna with the VLA in its A configuration in real-time, has been a successful and scientifically important capability. NRAO has offered this capability in every A configuration since October 2000, essentially doubling the angular resolution of the VLA for radio sources above declination +40 degrees, and significantly improving the east-west resolution for sources below this declination.

The next A configuration is currently scheduled for February 3, 2006 through May 15, 2006. It is the last A configuration that encompasses winter weather until late 2008. As we noted in previous *Newsletter* articles, EVLA construction may impact the availability of the Pie Town link because of changes to the online system and the schedules of both electronic and operations staff who support the link.

We had hoped to announce the availability or non-availability in this *Newsletter*, as it is the last issue before the relevant A configuration proposal deadline (October 3, 2005). Unfortunately, the EVLA construction and transition is sufficiently fluid that we cannot yet make a decision regarding support of the Pie Town link. We will however, make the decision about offering the link in the 2006 A configuration by late August 2005 and use the email "NRAO News for Proposers" distribution list to announce the decision, in enough time for proposals to be written. If you would like to subscribe to this list please email Lori Appel (*lappel@nrao.edu*). If you have questions about the VLA+Pie Town link, please contact the undersigned at *mclausse@nrao.edu*.

M. J. Claussen

VLBA Data Distribution Using ftp

For some time now it has been possible to download data from the VLA archive using ftp. Both public and proprietary data can be queried from *http://archive.nrao.edu*; proprietary data can only be downloaded by the proposers after obtaining a secure key from the data analysts (*analysts@nrao.edu*). It is also possible to ftp data from the VLBA archive, as has been announced in previous *Newsletters*. It is also necessary to obtain a key from the data analysts for proprietary VLBA data so that only the rightful owners may access the data.

VLBA data sets are generally larger than VLA data sets, and therefore magnetic tapes have been used to ship data to our VLBA users. However, many VLBA data sets are less than a few GBytes in size and should be easily downloadable within a few hours, even over transcontinental distances. Users should expect transfer times of about 1.5 - 2 hours per GByte. For almost all of the VLBA data this is still many factors faster than shipping tapes. Note that the VLBA scheduling program “sched” already accepts CORTAPE='FTP' in the key file for selecting the distribution medium. It is important that this method of selection be used as it allows operations to ignore tape shipping preparation and invoicing. Several users have reported their experience with ftp distribution of VLBA data, and they have been quite happy with this service.

It should be noted that for recent data (after mid-2004), the VLBA archive data contains FITS file(s) with added value, in addition to the raw data from individual correlator jobs. These “added-value” files can be recognized in the archive by their name (typically the experiment name and some setup parameters) and their format (FITSAIPS). Their file size is also given in the archive listing, in kilobytes. These additional files consist of multi-source files split to single frequency-IDs, have the polarization labels fixed (if needed), and are already sorted (again if needed). If data reduction is begun with these “added-value” files, a considerable amount of reduction time can be saved.

We strongly encourage users to try this more rapid method to retrieve VLBA archive data. We would like to challenge our system to help prepare for future heavier data traffic. Please report problems or suggestions to *lsjouwer@nrao.edu* or *jbenson@nrao.edu*. In this era of limited resources, we may not be able to immediately add hardware or completely solve all problems, but we want to gather information so we will be positioned to do so as soon as possible.

L. Sjouwerman, J. Benson, J.Robnett

Blank-field Extragalactic Surveys on the VLA

During the past two configuration cycles, the VLA has seen an increasing number of proposals requesting time allocations on the order of 100 hours to image areas covered by deep blank-field extragalactic surveys conducted by spacecraft and ground-based telescopes (e.g., HDF, CDF South, CGOODS, COSMOS, SWIRE). Our referees have had difficulty distinguishing among the proposals, and the 1000-word limit has made it very difficult for proposers to describe all their ancillary data in a fashion that can be understood by the referees. We have surveyed past and present proposers, referees, and the NRAO Users Committee to sample opinions on improving the process for assessment of these proposals.

For the next VLA cycle, extending from January/February 2006 (A configuration) through June 2007 (D configuration), we will change our method of evaluating these blank-field extragalactic survey proposals. To provide uniform refereeing and assessment, there will be a single proposal deadline, October 3, 2005, **only for** all proposals requesting a total of 40-199 hours of observing time for blank-field extragalactic surveys. This applies to VLA proposals only, and includes the total amount of observing time summed over all configurations. The blank-field category will include both deep integrations at a single pointing and shallower integrations at multiple pointings, to cover a wider field of view. Proposals fitting the above blank-field criteria that are received at the February, June, and October 2006 deadlines will be rejected and will not be refereed. Several proposals asking for A and B configurations have been held over from the previous cycle until the new evaluation method was in place; the PIs of these programs should submit new proposals that include the additional information described in the next paragraph. All proposers should state clearly in the abstract and the body of the proposal that they intend the proposal to be evaluated in the new blank-field category.

In addition to the normal 1000-word proposal limit, these blank-field extragalactic survey proposals will be allocated an additional two pages to describe two items: their ancillary data and the plans for making the VLA and other data available to the community and (if applicable) the National Virtual Observatory. A summary of all other observations of the extragalactic fields that are available to the proposal team will be most helpful to the referees. This summary should include a description of whether the ancillary data are in hand, if telescope time is already guaranteed, or if proposals for such data are submitted or anticipated in the future. Expected dates of availability of the ancillary data also should be provided.

The blank-field survey proposals will be refereed by approximately six to eight "normal" VLA/VLBA referees. Following refereeing, a panel will be convened to evaluate these proposals; the panel may meet in person or by teleconference, depending on the proposal demand. There will be no fixed time allocation for this type of proposal; it is our expectation, though, that we may grant 500-1000 hours to blank-field science during the next VLA configuration cycle, depending on proposal pressure and quality. Allocations made through the separate Large Proposal process may be considered in evaluating the uniqueness of the science of each blank-field proposal. If necessary, we will adjust the time spent in the different VLA configurations to respond to proposal pressure.

Potential proposers should be aware that we are in the midst of the EVLA construction project, and they should expect the possibility of having fewer than 27 antennas, as well as non-identical antennas in the array (most antennas will be "old style" VLA antennas, while a few antennas will have been retrofitted with new receivers and feeds). In particular, at 1.4 GHz, we have several antennas with new feeds that give much better performance at low elevations; and the differing polarization responses of old and new systems may complicate data reduction at this frequency. In mid-September, we expect to issue an update incorporating our latest predictions for the VLA status in 2006, and we advise prospective proposers to consult this as they complete their proposals. Because of the rapid evolution of the EVLA over the rest of this decade, we will determine at a later date whether to offer this separate blank-field opportunity again at a proposal deadline in 2007.

J. S. Ulvestad

Green Bank

The Green Bank Telescope

NRAO staff and university collaborators have made significant progress on a number of development projects in recent months. Version 1.0 of the GBTIDL data reduction package, an IDL-based reduction program with a command interface pattered after the Unipops program, was released on May 31, as scheduled. This package is user-friendly, efficient, and easily extensible by anyone familiar with IDL. The package reads and exports data in SDFITS format and can be used either offline or online at the telescope using the real-time SDFITS filler. The package is publicly available through Sourceforge at *http://gbtidl.sourceforge.net/*. GBT users who do not have access to an IDL license can arrange to log in to a dedicated IDL machine in Charlottesville.

The Astronomer's Integrated Desktop (ASTRID) package for observer control of the GBT is in its final stages of testing and development before initial release to observers this summer. Most staff astronomers and a few visiting observers are already using the package. This utility features a control panel for all the primary applications needed to configure and monitor GBT observations. It also features a Python-based scripting language and editor for composing and then queuing and executing observing scheduling blocks. The scheduling block system is very similar in concept to that planned for ALMA observing.

The Precision Telescope Control System (PTCS) group made good progress in the spring with the Out-of-Focus, or OOF, holography technique. The team has been successful in largely flattening the telescope gain-elevation curve by measuring and correcting large scale errors. The implied reflector surface error following OOF corrections is ~320 μm. Although further improvements will be needed for efficient observing at 3 mm, this figure should allow initial tests of the 3 mm Penn Array Camera to proceed next winter.

The Ka-band (26-40 GHz) receiver, which saw first astronomical use this past season, is being modified this summer to provide both polarizations, and the option of the cross-correlation outputs needed by the wideband spectrometer under construction by A. Harris (University of Maryland). It will be available for use again this fall. The Caltech Continuum Backend project, which will provide sensitive continuum capability for use with the Ka-band and future W-band (68-92 GHz) receivers, is also progressing. The FPGA firmware has recently been completed, and the designs for the hardware master and daughter cards have also been completed and submitted to an external firm for fabrication. Design and development work on the W-band receiver is proceeding well and has recently focused on the fabrication of cryostat lenses and a two-temperature thermal calibration load system. Work on the 64-pixel, 3 mm Penn Array bolometer camera has concentrated on detector development, the detector readout system, and software. Initial engineering test observations with this camera should begin this winter.

The azimuth track project group has nearly completed all design analyses and is presently obtaining preliminary cost estimates for track repairs and retrofits. The team expects to solicit bids this summer for field work to be done in the summer of 2007.

Green Bank is once again a beehive of activity as a number of summer students are in residence, supported by the Research Experiences for Undergraduated (REU) and NRAO student programs. Several of the students will travel to Arecibo in mid-July for the bi-annual NAIC/NRAO School on Single Dish Radio Astronomy.

P. R. Jewell

Education and Public Outreach

WISE Visits the Array Operations Center

Assistant Director Jim Ulvestad with students from Women in Science and Engineering program (WISE).

Students from the Women in Science and Engineering (WISE) program at the University of New Mexico (UNM), spent the morning of April 27 shadowing NRAO employees at the Socorro Array Operations Center to get a taste of how scientists and engineers spend their time. Assistant Director Jim Ulvestad welcomed the women and provided an overview of NRAO. Ulvestad addressed issues and challenges facing women in astronomy and science management, and those facing the NRAO in hiring women.

The students represented a variety of majors: astrophysics, biology, biochemistry, computer science; and civil, chemical, mechanical/manufacturing and nuclear engineering. NRAO scientists Debra Shepherd and Rick Perley hosted Rhiannon Griffith and Natalia McIver, respectively, demonstrating imaging software and explaining their current research.

The engineering students were treated to overviews of activity in the electronics labs. Engineers Chris Langley, Laura Newton and Gene DuVall toured the ALMA lab with Ana Gonzales. Everett Callan and Troy Jenson did the honors for the EVLA front-end lab with Sahar Abucker and Julie Archuleta.

The morning's activities culminated with the women joining the Observatory staff for the regular Wednesday lunch talk series

R. Harrison

New EVLA Exhibit Installed

A new exhibit was installed in April 2005 at the VLA Visitor Center that explains the major hardware and software modifications that are currently converting the VLA into the Expanded Very Large Array (EVLA). This new four-panel EVLA exhibit features a spectacular background image of the radio source Fornax-A with its twin radio lobes extending ~ 500,000 light-years on opposite sides of the elliptical galaxy, NGC 1316. The individual exhibit panels explain, e.g., the benefits of replacing the old stainless steel waveguide with a new fiber optic system that digitizes signals at the antenna. The expanded capabilities of the new correlator are described in graphics designed by Bill Saxton (NRAO – Green Bank) that explain recombination lines. The display was fabricated by Exhib-it! of Albuquerque. Robyn Harrison, Dave Finley, Rick Perley, Walter Brisken, Kerry Shores, and Mike Revnell all assisted with the design and text. A hardware display showing old waveguide and new optic fiber will be installed adjacent to the panels in the near-term future. This portion of the exhibit will give visitors a first-hand look at one of the many technology improvements being implemented at the EVLA that was unavailable when the VLA was built in the 1970's.

R. Harrison

The new EVLA exhibit is installed at the VLA Visitor Center.

Gerry Petencin places a balloon in liquid nitrogen to illustrate the use of cryogenics in noise reduction.

NTC Hosts TechTour

On March 3, 2005, forty high school students toured NRAO's Technology Center (NTC) as part of TechTour 2005. Sponsored by the Virginia Piedmont Technical Council and Piedmont Virginia Community College, TechTour is a one-day event that enables 10th and 11th-grade students from Central Virginia area schools to interact with technology professionals while touring and learning about local technology companies. This year's event hosted approximately 150 students and 27 technology companies. The program aspires to host roughly 1,500 students annually.

NTC hosted two groups of students who went on one of three tours of the facility. Dr. Richard Bradley led a group through an exploration of the sun's radio waves. Gerry Petencin brought his group into the deep freeze with a presentation on noise reduction and cryogenics, while John Effland explained radio receivers and how the observatory designs and tests them.

According to John Peterson, the event's founder and director, of the 124 student survey forms that were returned, the response was "unanimously and over-whelmingly positive." Student comments included: "Great event!" "I want to do it again." "Please do two per year." "TechTour rawks!" Yes, "rawks."

A. Gianopoulos

The NRAO at the American Astronomical Society Summer Meeting

The 2005 summer meeting of the American Astronomical Society (AAS) took place Sunday, May 29 through Thursday, June 2 at the Minneapolis (Minnesota) Convention Center with approximately 700 persons in attendance. NRAO Education and Public Outreach personnel (Dave Finley, Andrea Gianopoulos, and Mark Adams) staffed the Observatory's three-panel exhibit, with assistance from EPO Scientist Juan Uson, Director Fred K.Y. Lo, Assistant Director Jim Ulvestad, and scientists Paul vanden Bout and Brian Mason. Finley and Gianopoulos also assisted in the AAS press room throughout the meeting.

The 2005 NRAO / AUI Radio Image Contest was announced at this meeting. Contest details are described in an article by Juan Uson on page 26 and in the attached flyer. More than 200 flyers describing the contest were distributed at the AAS meeting in Minneapolis.

Free copies of a high-quality, color radio—optical composite image of the Fornax A radio source were also brought to the meeting and made available at the NRAO exhibit. This visually compelling poster proved popular and all 250 copies were soon claimed by meeting attendees.

NRAO Public Information Officers Andrea Gianopoulos and Dave Finley staff the Observatory's exhibit at the summer AAS meeting in Minneapolis.

As always, we enjoyed seeing and talking with the many AAS meeting attendees who visited the Observatory's exhibit to discuss progress on the NRAO's two major construction projects (ALMA and EVLA), to discuss the latest science and news from the Green Bank Telescope (GBT), the Very Large Array (VLA), and the Very Long Baseline Array (VLBA), or to learn how to participate in the Observatory's programs for researchers, teachers, and students.

M. T. Adams

In General

2005 Jansky Fellows Symposium

The first gathering of current and past Jansky Fellows took place in Charlottesville, Virginia on April 18-19. Approximately thirty current and previous fellows were in attendance. An opening reception took place the night before the symposium began. The first day of talks focussed on the work of current fellows, and the second day was devoted to the research of previous fellows. A barbecue dinner was held for all symposium attendees outside the newly-renovated Edgemont Road facilities. The talks provided overviews of research being done in certain areas (Neal Miller, *The VLA and Clusters of Galaxies*) and discussed recent results obtained at the NRAO and other observatories (Yancy Shirley, *The Earliest Stages of Pre-protostellar Core and Protostar Formation*). The talks were scintillating and engaging, producing much discussion during coffee and lunch breaks. Many past fellows remarked on the great impact that being a Jansky Fellow has had on their careers, both in terms of research directions and meeting people. Attendees were treated to a display of pictures from the life of Karl Jansky, narrated by Rachel Osten.

The current NRAO Jansky Fellows (back row, left to right): J. P. Macquart, Nissim Kanekar, Shami Chatterjee, Chris Groppi, and Yuri Kovalev; (front row, left to right): Vincent Fish, Andrew Baker, Yancy Shirley, Rachel Osten, Neal Miller, and Teddy Cheung.

The agenda for the symposium, with links to the talks in PowerPoint and PDF, is available on the web at *http://www.nrao.edu/library/jyfellows/agenda.shtml*. This symposium will be an annual event, rotating through the NRAO sites. We look forward to the second Jansky Fellows Symposium next spring!

Talk Titles:

Yancy Shirley, NRAO-SOC, *The Earliest Stages of Pre-protostellar Core and Protostar Formation*.

Chris Groppi, NRAO-TUC, *Submillimeter and Terahertz Technology for Interferometers and Focal Plane Arrays.*

Vincent Fish, NRAO-SOC, *Hydroxyl Masers in Massive Star-Forming Regions*.

Rachel Osten, NRAO-CV, *From Radio to X-ray: Flares (and Quiescence) on the dMe Flare Star EV Lacertae.*

Shami Chatterjee, CfA, *Much Faster than a Speeding Bullet: Pulsar Astrometry with the VLBA.*

Yuri Kovalev, NRAO-GB, *Fine Scale Structure of Active Galactic Nuclei.*

The past NRAO Jansky Fellows attending the symposium (back row, left to right): Dana Balser, Ingrid Stairs, Bryan Butler, Jim Higdon, Crystal Brogan, Tracy Clarke, and Min Yun; (front row, left to right): Jim Braatz, Toney Minter, Claire Chandler, Jennifer Wiseman, Chris Fassnacht, Henrique Schmitt, and Chris Carilli sporting the SKA bag.

J. P. Macquart, NRAO-SOC, *Scintillation in the Intra-Day Variable Quasar J1819+3845*.

Teddy Cheung, MIT, *Radio/X-ray Jets in the Highest Redshift Quasars.*

Nissim Kanekar, NRAO-SOC, *Do the Fundamental Constants Change with Time?*

Andrew Baker, UMd, *Submillimeter Galaxies and Mass Assembly*.

Neal Miller, JHU, *The VLA and Clusters of Galaxies*.

Crystal Brogan, IfA, *Recent SMA Observations of the Hot Cores G12.89+0.49, W33A, and CepA2.*

Claire Chandler, NRAO-SOC, *SMA Observations of Protostars: A Taste of ALMA*.

Michael Rupen, NRAO-SOC, *Lighting Up and Shutting Down Relativistic Jets.*

Jennifer Wiseman, NASA-HQ, *Adventures in Science Policy and Oversight.*

Min Yun, UMass, *A Multi-Wavelength View of ULIRGs Present and Past.*

Ingrid Stairs, UBC, *Timing Binary Pulsars.*

Henrique Schmitt, NRL, *Multi-Wavelength Study of Nearby Starforming Galaxies.*

Bryan Butler, NRAO-SOC, *VLA Observations of Solar System Bodies.*

Jim Higdon, Cornell, *The Nature of Optically Invisible Sources in the NOAO Bootes Survey*.

Tracy Clarke, NRL, *Probing Galaxy Cluster Cores with Radio and X-ray Observations*.

Dave Thilker, JHU, *HI Throughout the Circumgalactic Environment of M31 and M33*.

Kelsey Johnson, UVA, *Probing the Birth of Super Star Clusters.*

Toney Minter, NRAO-GB, *Tiny Scale Structure in the ISM.*

Chris Fassnacht, UC Davis, *The Mass Sheet Degeneracy and the Hubble Constant from Gravitational Lenses*.

R. A. Osten

NRAO/AUI Radio Astronomy Image Contest

The NRAO is calling for submissions to its first annual Radio Astronomy Image Contest, which is sponsored by Associated Universities, Inc. (AUI), NRAO's parent organization. We hope to involve the community in a significant way and provide a means to showcase the community's work through its publication in the Image Gallery as well as a yearly Calendar, and a series of Posters. We welcome images that display multi-wavelength information and contain data obtained with any telescope but request that they should contain and showcase radio emission observed with an NRAO telescope.

The Prizes are sponsored by Associated Universities, Inc. (AUI) which will award a First Prize, a Second Prize and up to ten Honorable Mentions consisting of: First Prize: $1,000; Second Prize: $500; Honorable Mentions: $100 each. The prizes will be awarded by a panel of scientists appointed by the NRAO that will include one scientist who is not a member of the Observatory's staff. The panel membership will be made public when the contest results are announced. The deadline for submission is September 1, 2005. The winners will receive email notification and will be announced on the NRAO web pages by October 15, 2005.

Details of the contest as well as a submission tool can be found on the NRAO web at: *http://www.nrao.edu/image-contest.html* while some of the most relevant details can also be found in the flier enclosed with this *Newsletter*.

We expect that the contest will add significantly to the NRAO Image Gallery, which has been on-line since 2002 (*http://www.nrao.edu/imagegallery/php/level1.php*). The Gallery contains radioastronomical images which are organized by object classes and can be browsed using a comprehensive Search Tool with links to the NASA Extragalactic Database (NED), the SIMBAD database and also to the corresponding scientific and popular papers. The Image Gallery includes a web-based submission tool (*http://www.nrao.edu/imagegallery/php/ext_sub.shtml*) which can be used to upload images using a web browser.

J. M. Uson

Research Assistant Receives Sigma Xi Grant for Neutrino Search

Erin Mastrantonio

Erin Mastrantonio, an NRAO research assistant at the NTC Dynamic Spectroscopy Laboratory, recently received a $2,000 grant from Sigma Xi to search for evidence of high-energy neutrinos that produce radio Cerenkov radiation upon interacting with the lunar regolith. Over the past year Erin has been helping to develop a dual-polarized, 300-2500 MHz wide-bandwidth feed and receiver for the Green Bank 45-Foot Radio Telescope as part of the Solar Radio Burst Monitor (GB/SRBS) project. Erin plans to develop a unique, high-speed, data acquisition and signal processing system as a secondary back-end to GB/SRBS for the neutrino search. This work builds upon earlier work of Hankins et al. (Mon. Not. R. Astron. Soc. 283, 1027), Gorham et al. (Phys. Rev. Lett. 93, 041101), and others with the goal of either refining the upper limit on the neutrino flux or perhaps showing evidence for a direct detection. In either case, this experiment will add to our understanding of cosmic accelerators and ultra-high energy particles. Erin has been with the NRAO since receiving her undergraduate degrees in physics and philosophy from Lycoming College in 2004. She will attend the University of Virginia beginning in Fall 2005 to pursue a graduate degree in electrical engineering. Under the guidance of Rich Bradley and Joe Lazio (NRL), the neutrino search activities will serve as her Masters thesis project. Funding for the data acquisition hardware will be provided by the Naval Research Laboratory.

R. F. Bradley

First Grote Reber Medal Awarded to Bill Erickson

W. C. Erickson (photo courtesy of Hillary Cane)

The 2005 Grote Reber Medal has been awarded to W. C. Erickson, Professor Emeritus at the University of Maryland and Honorary Research Associate at the University of Tasmania in Hobart, Australia. Erickson was recognized for his innovative contributions to radio astronomy, especially for developing novel techniques that have been the forerunner of electronically-steerable radio telescopes developed for meter wavelength-astronomy. Currently Erickson operates his own private radio observatory on Bruny Island in Tasmania where he observes solar radio emission. Earlier in his career Professor Erickson studied the turbulence in the solar corona, investigated the nature of the first fast millisecond pulsar, and made one of the first detections of very high Rydberg state atoms in the cold interstellar medium. More recently, he has been leading a group of his former students and others doing sub-arcminute resolution imaging of radio sources at 4-meter wavelength using instrumentation which they developed and installed on the NRAO VLA.

Professor Erickson obtained his undergraduate and graduate education at the University of Minnesota where he received his Ph.D. degree in 1956. Following appointments at St. Thomas College in Minnesota, the University of Minnesota, the Carnegie Institute, and the Convair/General Dynamics Corporation in California, Erickson spent a year in Leiden as the leader of the group developing the Benelux Cross Radio Telescope. While he was a professor at the University of Maryland from 1963 to 1988, Erickson, together with his students, developed a succession of innovative low-frequency radio telescopes at Clark Lake in the Anza-Borrego Desert east of San Diego, California. Erickson has trained and inspired his many students, creating a group of skilled scientists who, along with Erickson, are developing a new generation of meter wavelength radio telescopes.

The Grote Reber Medal is awarded annually for innovative lifetime contributions to radio astronomy. The Medal is administered by the Queen Victoria Museum in Launceston, Tasmania in cooperation with the University of Tasmania, the CSIRO Australia Telescope National Facility, and the U. S. National Radio Astronomy Observatory. The 2005 Prize will be awarded at a ceremony in early December 2005 during an international conference on radio astronomy being held at the University of Tasmania in Hobart, Australia.

The award of the Grote Reber Medal is made possible through funds provided by the estate of Grote Reber.

K. I. Kellermann

The John Kraus Archive at the NRAO

The NRAO Archives is pleased to announce the gift from estate executor John Kraus Jr. of the papers and correspondence of his father, John Kraus, who died in July 2004 at the age of 94. Kraus joined the faculty at Ohio State University in 1946. He was a professor of electrical engineering and astronomy, and founded and directed the OSU Radio Observatory, where he designed and built the “Big Ear” radio telescope. His antenna designs include the bi-directional wire beam antenna, the corner reflector, and the helical antenna, used in communication and global positioning satellites. Kraus wrote *Antennas* and *Radio Astronomy*, two classic titles familiar to and still used by radio astronomers, as well as the autobiographical *Big Ear*.

He was a long-time radio amateur, licensed as W8JK. Kraus served on the National Science Foundation committee, convened in 1954, that wrote the initial feasibility study for a national radio astronomy facility and recommended Green Bank as the site for what became NRAO. The Kraus papers include family and professional correspondence and papers, awards and certificates, photographs, and other materials covering a period from the 1920s until John Kraus' death in 2004.

The NRAO Archives has been established to seek out, collect, organize, and preserve institutional records and personal papers of enduring value which document NRAO's historical development, institutional history, instrument construction, and ongoing activities. As the national facility for radio astronomy, the NRAO archives will also include materials on the history and development of radio astronomy in the U.S., particularly if such materials are in danger of being lost or discarded by other institutions or individuals.

For further information, please contact NRAO Archivist Ellen Bouton, *ebouton@nrao.edu*.

E. N. Bouton

The ALMA site (view to north) in the Andean Altiplano of northern Chile. The sites for the Cosmic Background Imager (CBI) and the Atacama Pathfinder Experiment (APEX) are also indicated. Copyright 2004 E&S, Caltech, photo credit Jane Dietrich.

Further Information

To obtain more information on the NRAO, visit the NRAO home page at: *http://www.nrao.edu*

To Contact any NRAO Site

Headquarters
Director's, Human Resources, Business Offices
Atacama Large Millimeter Array
North American ALMA Science Center
Charlottesville, Virginia
(434) 296-0211

Green Bank Site
Green Bank Telescope
Green Bank, West Virginia
(304) 456-2011

Array Operations Center
Very Large Array
Very Long Baseline Array
Socorro, New Mexico
(505) 835-7000

Tucson Site
ALMA Tucson
Electronics Division
Tucson, Arizona
(520) 882-8250

NRAO Results

For more information on recent scientific research with NRAO telescopes:

NRAO Press Releases: *http://www.nrao.edu/pr*
NRAO Preprints: *http://www.nrao.edu/library/listings/nrao_current.shtml*
Current VLA Observation Highlights: *http://www.vla.nrao.edu/genpub/current_obs/*

NRAO Products

VLA NVSS Survey (VLA D-array 20 cm continuum): *http://www.cv.nrao.edu/nvss/*
VLA FIRST Survey (VLA B-array 20 cm continuum): *http://www.cv.nrao.edu/first/*
Galactic Plane "A" Survey: *http://www.gb.nrao.edu/~glangsto/GPA/*
The NRAO Data Archive System can be accessed and queried via the web: *http://e2e.nrao.edu/archive/*
Green Bank Solar Radio Burst Spectrometer (SRBS): *http://www.nrao.edu/astrores/gbsrbs/*

Observing Information

VLA: *http://www.vla.nrao.edu/astro*
VLBA: *http://www.aoc.nrao.edu/vlba/html/vlbahome/observer.html*
GBT: *http://www.gb.nrao.edu/astronomers.shtml*
Information on proposal templates, instructions, and deadlines can be found at:
http://www.nrao.edu/administration/directors_office/

Publicizing NRAO Results

If you have a new research result obtained using an NRAO telescope that might be of interest to a wider audience, please write a 2-3 sentence description of the result and email it to one or more of the persons listed below. Your information could result in a press release, an article in this Newsletter, and/or inclusion of your image in the NRAO Image Gallery.

Press release contact Public Information Officers: Dave Finley (*dfinley@nrao.edu*) or
Andrea Gianopoulos (*agianopo@nrao.edu*)
Newsletter contact: Mark Adams, Editor (*mtadams@nrao.edu*)
Image Gallery contact: Patricia Smiley, Information Services Coordinator (*psmiley@nrao.edu*)

NRAO Page Charge Policy

It is NRAO policy to pay a portion of the page charges for articles reporting original observations made with NRAO instruments or utilizing NRAO archival data. For more information and for details of the policy requirements, please see: *http://www.nrao.edu/library/page_charges.shtml*.