NRAO Newsletter

The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc.

July 2003 www.nrao.edu/news/newsletters **Number 96**

DIRECTOR'S OFFICE

NRAO Organization

Over the past eight months, I have delved into the operations of the NRAO in considerable detail in order to understand the many issues that the Observatory faces as we continue to grow and improve. Over this time span there have been a number of changes, and I have most recently enlisted the help of a few senior colleagues to oversee various important areas of the Observatory, in order to focus my attention on the long range goals for the Observatory and various key issues that may arise.

The six existing divisions of the Observatory are Green Bank Operations, New Mexico Operations, Administration, Data Management, Central Development Lab, and the ALMA Project. As indicated below, the ALMA Project will now become part of a new ALMA Division, and a seventh new unit will be the Division of Science and Academic Affairs (DSAA). Three other units, Human Resources, Education and Public Outreach, and Safety, Security, and Environment, report directly to the NRAO Director, but also interact with all the divisions.

The focus of the NRAO Deputy Director position is being returned to administrative aspects of Observatory operations, which includes oversight of the reporting requirements of Associated Universities, Inc. (AUI) and the National Science Foundation (NSF). I am pleased to announce that Dave Hogg has agreed to serve as Interim Deputy Director.

The ALMA Project: NRAO-ESO site testing area at Chajnanator, Chile. (Image courtesy of ESO).

To ensure that ALMA receives the full-time attention it deserves and requires, the new ALMA Division within the Observatory will incorporate and coordinate all NRAO activities involved with ALMA: the ALMA Construction Project, North American ALMA Chilean Operations, and the U.S. ALMA Science Center in Charlottesville. ALMA Construction will continue under the guidance of the North American Project Manager, Marc Rafal. In the meantime, preparations will start for organizing Chilean Operations and the U.S. ALMA Science Center, which will provide support for U.S. ALMA users during the operational phase. I am happy to announce that Darrel Emerson has agreed to serve as Head of the ALMA Division for an initial term of up to three years. The Head of the ALMA Division will report to the Director of NRAO.

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To provide a more coherent framework for the scientific and academic activities at the NRAO and to facilitate interaction and collaboration with the university community, a new Division of Science and Academic Affairs (DSAA) is being formed. While discussions are continuing with an NRAO ad-hoc advisory committee, the division's structure will be in place by the summer of 2003. The activities coordinated by the DSAA will include library operations, archives, summer students, pre-doctoral students, co-op students, the visiting scientist program to NRAO, NRAO staff visits to universities, colloquia series and NRAO sponsored conferences, proposal review and telescope time assignment, data analysis funding (budget permitting), administering all NRAO postdoctoral programs, research support for the scientific staff, and the Observatory Tenure and Appointments Committee. I am grateful that Miller Goss has agreed to help plan the DSAA and to serve as its first Head for a term of up to three years.

To advise the NRAO Director on scientific issues, an Observatory Science Council (OSC) will also be formed over the next few months, and the Head of the DSAA will serve as chair. For similar purposes on technical and computing matters, an Observatory Technical Council and an Observatory Computing Council were formed and have been functioning for a few months now.

Other recent and past changes during this current year include the appointment of Gareth Hunt as Interim Associate Director for Data Management, following the decision of Tim Cornwell to return to research activities as a member of the scientific staff. The AIPS++ consortium has ended, but details and future plans for NRAO use of the AIPS++ code base are described elsewhere in this Newsletter. Since the start of the year, Ted Miller has assumed the role of Head of Observatory Business Services and Juan Delgado was hired into the new position of Manager of Contracts and Procurement.

I am sure that with these operational changes, the NRAO will be better positioned to successfully meet current and future challenges and build on its reputation as a global leader in astronomy research.

K. Y. Lo

AIPS++ Status

In April, the AIPS++ Executive Committee ended the AIPS++ Consortium, meaning that the international AIPS++ project has come to a close. The concept of a general purpose software package that can address all radio astronomy needs and developed jointly by radio observatories in the world is very appealing indeed. Unfortunately, the specific needs of each Observatory have outpaced this very ambitious and visionary project.

Within the NRAO, the emphasis is necessarily shifted toward efforts more specifically targeted to the needs of the various major projects ongoing within the Observatory, such as GBT, ALMA, VLA, VLBA, EVLA and end-to-end data management (e2e). At the same time, the software efforts are expected to have wider involvement and participation by scientific and software staff both within and external to the NRAO.

Both AIPS++ and AIPS still exist as software packages and will continue to be used whenever appropriate. The code base generated by both software projects remains available to all under the GNU Public License, held by Associated Universities. All future development plans and enhancements to data reduction software solutions will be more tightly coupled with the demands of NRAO projects, but will also take advantage of resources existing throughout the Radio Astronomy community.

The core capabilities of AIPS++ will not be lost, but can be expected to evolve over the upcoming months, perhaps very significantly. It is anticipated that future developments will make appropriate use of its functionalities, and will evolve in a way that can incorporate software tools and systems developed outside of the NRAO. Informal collaboration between erstwhile Consortium members is expected to continue productively.

The NRAO remains fully committed to the delivery of software to enable its facilities to be widely accessible to all astronomers, not only radio astronomers. Therefore, e2e capabilities from proposal submission, all the way through data archiving, will be of primary focus. At the same time, the NRAO will provide the necessary software that is deployable from the desktop to deal with the data from ALMA, EVLA, the GBT, and of course VLA/VLBA.

K. Y. Lo

ALMA

Three prototype antennas at the ALMA Test Facility (ATF) located at the VLA.

The ALMA Test Facility

Those of you who have recently visited the VLA have probably noticed that there are three new telescopes being constructed to the northeast of the VLA Cafeteria. These three antennas, located within what is referred to as the "ALMA Test Facility (ATF)," are prototypes associated with the ALMA Project. The photograph shows the state of the site as of May 29, 2003. In addition to the European ("AEC Antenna") and North American ("VertexRSI Antenna") ALMA prototype antennas, installed along an east-west baseline, the ATF includes three instrument towers which house weather, surveillance, and holography instrumentation, and two trailers, one for ALMA and a second for contractor use. The two prototype antennas are currently being evaluated by a joint group of scientists and engineers from the ALMA partners. The third prototype antenna ("NAOJ Antenna"), being built by the National Astronomical Observatory of Japan (NAOJ), is being considered as a potential prototype for the Atacama Compact Array (ACA), a possible enhancement to ALMA. The NAOJ antenna and its associated infrastructure is located on the left side of the photograph.

The two ALMA prototype antennas are being evaluated using a uniform set of criteria which gauge their relative performance. These evaluation tests include measurements of the surface accuracy, pointing characteristics, fast motion capabilities, and path length stability of these antennas. Evaluation of these prototype antennas will conclude in early 2004.

J. S. Kingsley, J. Mangum

NRAO Charlottesville Technology Center

In February of this year, the NRAO announced that ALMA activities currently underway in Tucson will be consolidated in Charlottesville beginning in the summer of 2004. Since that time, many people have been working hard to complete the detailed planning required to carry out this transition while maintaining ALMA Project schedules. Some of these plans focus on bricks, mortar, and Ethernet routers. Others involve organizational realignments. The impact of these changes will not only directly apply to those who will transfer from Tucson, but also to the technical staff already in Charlottesville.

Our present plans call for those people currently housed at the Central Development Lab (CDL) and those transferring from Tucson to be collocated at a new facility called the NRAO Charlottesville Technology Center (NCTC). The NCTC will be in close proximity to the NRAO Headquarters building on the campus of the University of Virginia. When the consolidation is complete, the NCTC will house laboratory and office space for more than eighty people. The physical layout and completion schedule are at NSF for approval.

Among the primary benefits of the consolidation is the opportunity to merge all of the ALMA Front End and Local Oscillator work carried out by the NRAO into a single location. In order to best capitalize on that opportunity, we have announced that all of the Front End and LO work currently carried out at both the CDL and Tucson will be reorganized into a single group under the ALMA Project manager. This new group will be managed by John Payne, with Antonio Perfetto as his deputy.

The ALMA Baseline Correlator will remain a part of the CDL under the leadership of John Webber. In addition, the

CDL will retain those development and fabrication activities that support the GBT, VLA, EVLA and VLBA. CDL staff will also focus on research to extend current techniques and develop the advanced technologies that will make new capabilities available to fill future requirements.

Special thanks are due to the dedicated people who have provided great service to the Observatory by helping develop the plans for these relocations and organizational changes. Of particular note are the contributions of Jeff Kingsley, Antonio Perfetto, Richard Bradley, Wes Grammer, Bill Porter and Dale Webb. They and others continue to spend many hours ensuring a successful transition.

M. D. Rafal

GREEN BANK

The GBT

The GBT is approaching routine operation. During the months of March through May, more than 45 percent of the total telescope time went to refereed observing proposals. This percentage will grow as the year progresses. Although there are still a number of enhancements underway, the basic capabilities are available for use. The commissioning phase is thus drawing to a close. Most of the scheduled test time is now used for checking out the capabilities needed for specific observing programs.

Although observing programs are being scheduled at an increasing pace, we have a considerable queue of projects from previous calls. We expect to work this queue down over the next year, but to achieve this, we are limiting the amount of new time accepted to about 400 hours at each of the next three observing deadlines (June and October 2003 and February 2004). We hope to approach a steady state after that in which the amount of time available is significantly larger, and the amount accepted is equal to that available in the subsequent trimester.

Commissioning of the 18-26.5 GHz (K-band) system was concluded this winter, including confirmation of beam-switched observing and use of the active surface. A number of K-band observing programs were carried out this spring. The aperture efficiency using the active surface is 55-60 percent over elevation ranges from 15 to 80 degrees. We also performed initial engineering tests of the 40-52 GHz (Q-band) system this spring. Both the receiver and active surface appeared to be performing well. The aperture efficiency at Q-band was measured at ~35 percent. The K- and Q-band efficiencies are consistent with an effective surface RMS of about 450 microns. The beam response at Q-band was also very good, with sidelobes <-20 dB. We will complete commissioning and schedule the first observing programs at Q-band this fall.

In April, we held a conceptual design review for the Precision Telescope Control System, that will allow the GBT to operate efficiently at 3 mm wavelengths. The review panel was comprised of Peter Napier (chair), Patrick Wallace, and David Woody. The panel issued a very favorable review of the concept and approach, but cautioned us about staffing and scheduling pressures. The immediate goal of the project is to achieve efficient operation at Q-band (up to 50 GHz) this autumn, then proceeding to efficient 3 mm observing by early 2005.

The primary development programs underway at the GBT are the PTCS, the 26-40 GHz (Ka-band) receiver, and associated common down-converter module. A 3 mm receiver is also under development, although work this year has been temporarily suspended while other projects are being addressed. Initial research and development of a 1.5 GHz beam-forming array is also underway. Externally, we are collaborating with the University of Pennsylvania, NASA-Goddard, NIST, and the University of Cardiff on a 64-pixel bolometer camera for the 3 mm band. We are also collaborating with Caltech on a fast-switching continuum backend for use with the Ka-band and 3 mm receivers. Operational development has centered on improving spectral baselines, increasing both hardware and software reliability of the autocorrelation Spectrometer, and providing user software for easier configuration of the telescope.

There have been a number of developments over the past few months with the azimuth track. As reported previously, there has been a series of problems with the track that include fretting wear between the two layers of the steel track, breakage of track plate hold-down bolts, and perhaps most seriously, a number of cracks in the wear plates that were first found this past January. We temporarily restricted the number of wheel-passes allowed over the cracked plates and the minimum temperature for operation to prevent the cracks from worsening.

Following the detection of the cracks, our antenna engineering team placed an expedited order for several replacement wear plates. Replacement of the three most seriously cracked plates was completed in early April, and the azimuth motion restrictions were lifted. We have not observed any worsening of the cracks since their initial detection in January, but have sent out sections of one of the cracked plates for metallurgical analysis.

We continue with the overall plan recommended by the azimuth track review panel, as described in the January 2003 Newsletter. We expect this plan to lead to a permanent solution to the track problems. In June, we plan to weld one base plate joint together and to bridge it with a wear plate, i.e., so that the joints between the base plate and wear plate do not line up. It was a major recommendation of the review panel that we perform this modification at one joint and test it as a possible remedy for the track problems. Our engineering team has also completed an analysis of the wheel flex plates, and has contracted out a finite element analysis of the track itself. We have also begun research into new track designs, which is the alternative option to the track retrofit. We expect to have these design studies and field trials completed and ready for review by the end of this year.

P. R. Jewell

GBT Student Support Program: Announcement of Awards

Four awards were made in May as part of the GBT Student Support Program. This program is designed to support GBT research by graduate or undergraduate students at U.S. universities, thereby strengthening the proactive role of the Observatory in training new generations of telescope users.

The May awards were in conjunction with approved observing proposals submitted at the February deadline. Awards were made for the following students:

* J. Eisner (Caltech) in the amount of $3,000 for the proposal entitled *"Water Masers Around Herbig Ae/Be Stars."*

* S. Schnee (Harvard U) in the amount of $35,000 for the proposal entitled *"The GBT HI Narrow Self Absorption Survey of Star Forming Regions."*

* C. Springob (Cornell U) in the amount of $35,000 for the proposal entitled *"A Drift Scan HI Survey of the Virgo Cluster Region and Its Foreground."*

* S. Widicus (Caltech) in the amount of $22,500 for the proposal entitled *"A Search for Sugars in Hot Cores."*

New applications to the program may be submitted along with new GBT observing proposals at any proposal deadline. For full details, restrictions, and procedures, please visit *http://www.gb.nrao.edu* then select "student support program". Questions on the program may be directed to Joan Wrobel (*jwrobel@nrao.edu*, phone 505-835-7392) in her role as GBT Student Support Coordinator.

J. M. Dickey (U Minn)
J. E. Hibbard, P. R. Jewell, F. J. Lockman,
J. M. Wrobel (NRAO)

SOCORRO

VLA Configuration Schedule; VLA / VLBA Proposals

Configuration	Starting Date	Ending Date	Proposal Deadline	Note
A(+PT)	30 May 2003	08 Sep 2003	3 Feb 2003	
BnA	19 Sep 2003	06 Oct 2003	2 Jun 2003	
B	10 Oct 2003	05 Jan 2004	2 Jun 2003	*1*
CnB	16 Jan 2004	02 Feb 2004	1 Oct 2003	*1*
C	06 Feb 2004	10 May 2004	1 Oct 2003	*1*
DnC	21 May 2004	07 Jun 2004	2 Feb 2004	*1*
D	11 Jun 2004	13 Sep 2004	2 Feb 2004	*1*
A(+PT)	01 Oct 2004	10 Jan 2005	1 Jun 2004	

Note: *1* It is possible that the duration of B configuration could be extended by one or two weeks, with that extension then subtracted from the durations of the C and/or D configurations.

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 US standard letter paper. Proposals may also be sent by paper mail, as described at the web addresses given above. FAX submissions will not be accepted. 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 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 degrees 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 (tropospheric phase variations, especially in summer). Proposers should defer such observations for a configuration cycle to avoid such problems. In 2004, the C configuration daytime will involve RAs between 19^h and 03^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
2003	D	D,A	A,B	B
2004	C	D	D,A	A
2005	B	B,C	C	D
2006	D,A	A	B	C

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 justify, quantitatively, 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 dynamics requesting frequencies below about 10 GHz. When the VLA-Pie Town link is in use during the VLA's A configuration, we will try to substitute a single VLA antenna for Pie Town in a concurrent VLBA dynamic program. Therefore, scheduling prospects will be enhanced for VLBA dynamic programs that can accommodate such a swap. See *http://www.aoc.nrao.edu/vlba/schedules/this_dir.html* 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. 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 bilateral 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.

B.G. Clark, J. M. Wrobel
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22/43 GHz Receiver Status

As of May 2003 all VLA antennas have been outfitted with 43 GHz (Q-band) receivers. In parallel, the antenna panels have been readjusted using 43 GHz holography to improve aperture efficiency (see VLA test memo 234). These panel adjustments lead to forward gains for the VLA antennas between 30 percent and 40 percent at 43 GHz.

The 22 GHz (K-band) receiver upgrade is near completion. There are now 26 antennas that have the new 22 GHz receivers installed, and the final two receivers will be the first of the EVLA upgrade. The LO chain will be modified for the increased bandwidth, and the receivers will be installed as the antennas pass through the antenna assembly barn. The final 7 receivers are all outfitted with the most recent "Cryo 3" LNAs and a new feed horn design, which has lead to a significant improvement in receiver temperature and stability across the band. Currently typical 22 GHz receiver temperatures due to all sources except the atmosphere are around 35 K. The sky and spill-over typically contribute another 15 K.

Y. M. Pihlstroem, C.L. Carilli

VLA/VLBA Rapid Response Scheduling

We are modifying our policies for Rapid Response Scheduling at the VLA and VLBA. Late last year, a committee was formed to evaluate our current policies and procedures, and to recommend changes. This committee was chaired by Claire Chandler. Its membership included Sean Dougherty (Herzberg Institute of Astrophysics), Shri Kulkarni (Caltech), Steve Myers (NRAO), Peggy Perley (NRAO), Steve Thorsett (UC Santa Cruz), Kurt Weiler (Naval Research Laboratory), and Joan Wrobel (NRAO). Their recommendations have been folded into another review (chaired by Dave Hogg) of all NRAO telescope allocation practices.

Results of the telescope-allocation review are being presented to the NRAO Users Committee in mid-June 2003, after this newsletter goes to press. Pending approval by that group, we plan to implement the new policies for the October 1 NRAO proposal deadline. The details of these policies will be posted to the VLA and VLBA web sites by July 31, 2003; please look under "Proposer Information & Documentation" at *http://www.vla.nrao.edu/astro/* for the finalized policies. These policies will apply to both the VLA and the VLBA.

Please note that we plan to revise the proposal cover sheets by the end of July in order to enable proposers to specify the type of Rapid Response Science that they are proposing. Also note that all such proposals will require submission of a completed cover sheet, in addition to a scientific justification with a maximum of 1000 words. (In some cases, a single paragraph may suffice.) Any proposal submitted without a cover sheet would be rejected.

At this writing, we anticipate the following three categories of Rapid Response Science proposal:

(1) Known Transient Phenomena: These proposals will request time to observe phenomena that are predictable in general, but not in specific detail. For example, a proposal to observe the next flaring X-ray binary that meets certain criteria would be included in this category. Specific triggering criteria will be required. These proposals will be evaluated as part of the normal refereeing and scheduling process, and will be subject to the normal NRAO proposal deadlines.

(2) Exploratory Time: These proposals are close in nature to those formerly called "Ad-Hoc" proposals. Examples include B configuration proposals that follow up on A configuration discoveries made after the B configuration proposal deadline, or a newly identified SiO maser source that is a hot enough topic to warrant a VLBI image within a couple of months. In general, there will not be a need for immediate scheduling of these proposals, but they may need to be observed in the current VLA configuration rather than waiting 16 months, or should be observed with the VLBA without waiting for an entire proposal cycle and possible dynamic scheduling. Proposals for Exploratory Time will be evaluated by the VLA/VLBA Scheduling Committee, and may or may not be sent to external referees. The possibility that a proposer forgets about or misses a proposal deadline will not constitute sufficient justification for granting of observing time by this process.

(3) Targets of Opportunity: These proposals are for true targets of opportunity—unexpected or unpredicted phenomena such as supernovae in nearby galaxies, or extreme X-ray or radio flares in various types of objects. These proposals will be evaluated rapidly, with rapid decisions returned, and scheduling done as quickly as possible and as warranted by the nature of the transient phenomenon.

In general, there may be reduced proprietary periods for one or more classes of the proposals outlined above, particularly in cases where the proposals do not go through the normal refereeing process. We anticipate that we will make room for the Rapid Response Time proposals either by leaving gaps in the schedules (already done for the dynamically scheduled VLBA) or by approving some proposals at low priority, with the understanding that they can be bumped from the schedule. Details in this area are not yet finalized, and are awaiting the recommendations of the Users Committee.

Please see the VLA or VLBA web sites on July 31, when we expect to provide the final policies.

J. S. Ulvestad, J. M. Wrobel, B. G. Clark

VLA and VLBA Large Proposal Results

The skeptical review committee for large VLA and VLBA proposals has met twice in the last year. This committee is made up entirely of scientists from outside NRAO, who consider the broad scientific impact of large observing proposals in their deliberations. They met by teleconference late in 2002 in order to discuss two VLBA large proposals. Then, they held a face-to-face meeting in early 2003 to discuss the seven VLA large proposals that were submitted at the October 1, 2002 proposal deadline. During these meetings, they discussed the importance of the proposals, and also were advised of their logistical impact on other VLA and VLBA observing by the Assistant Director for Socorro Operations. In the end, it is the intent of the NRAO to implement all the recommendations of the skeptical review committee.

Both submitted VLBA proposals were accepted for some fraction of their proposed time; three of the seven VLA proposals were accepted for most or all of their proposed time, while a fourth was accepted as a pilot project for a small fraction of the time. (Some of these acceptances are conditional on submission of more specific plans for data analysis and release of data products.) The requested VLA time was heavily concentrated in the B and C configurations, and two of the accepted proposals will require a large amount of B configuration time. The total amount of scientific observing time available in a single configuration typically is about 1500-1600 hours, and the allocated B configuration time would occupy a significant fraction of an entire configuration. Therefore, we expect to carry out some of the large-proposal observations over two configuration cycles. It also is possible that the time spent in the B configuration in late 2003 and early 2004 may be extended by one or two weeks beyond the nominal time range.

The table below gives the amount of time requested and allocated in different configurations for the VLA large proposals:

Configuration	No. Proposals	Hr. Requested	Hr. Allocated
A	1	105	0
Bna	5	436	211
B	6	1783	716
CnB	1	6	6
C	3	840	288
DnC	1	5	5
D	1	55	37
ALL	7	3230	1263

Below, we list the proposal codes, PIs, and titles for which observing time was granted via the skeptical review process:

- BC120, S. Chatterjee et al., "Pulsar Astrometry with the VLBA." 300 hours of VLBA time allocated from 2002 through 2004.

- BL111, M. Lister et al., "The MOJAVE Program: Monitoring of Jets in AGN with VLBA Experiments." 7 VLBA sessions per year, of 24 hours each, allocated over an 18-month period.

- AK563, J. Kenney et al., "Virgo: A Laboratory for Studying Galaxy Evolution." 240 hours of VLA C configuration time allocated, to be spread over the next two cycles.

- AP452, R. Perley et al., "A 4-Meter All Sky Survey (4MASS)." 500 hours of B configuration and 190 hours of BnA configuration allocated, to be spread over the next two configuration cycles. Some makeup time also will be allocated for observations damaged by poor ionospheric conditions.

- AW605, F. Walter et al., "Stuff that Matters: The Physical Conditions of the ISM in Nearby Galaxies." Time allocated in multiple configurations, including 176 hours of B configuration, 48 hours of C configuration, 37 hours of D configuration, 21 hours of BnA configuration, 6 hours of CnB configuration, and 5 hours of DnC configuration.

- AH810, M. Hoare et al., "The Coordinated Radio and Infrared Survey for High-Mass Star Formation (The CORNISH Survey)." 40 hours of B (or BnA) configuration allocated for a pilot program.

As a reminder to prospective proposers, VLBA large proposals may be submitted at any of the standard NRAO deadlines. The next deadline for VLA large proposals will be February 2, 2004. More detailed information about the large proposal process, and links to results from previously scheduled large proposals, may be found at *http://www.vla.nrao.edu/astro/prop/largeprop.*

J. S. Ulvestad

VLBA Correlator Output Data Rate Limit Increased

The VLBA correlator's operational output data rate limit has been raised to 1000 kB/s, for all observing modes, effective May 9, 2003 . The new policy was announced via the "vlbi" e-mail distribution list.

The new science enabled includes wide-field imaging of the microJy sky and high-resolution spectroscopy of masers.

Correlation parameters yielding rates up to this new limit may be specified in VLBA proposals submitted henceforth. Higher output rates may also be requested for observations proposed previously, but not yet observed as of May 9, by sending a revised *Sched* file with the desired new correlation parameters to: *vlbiobs@aoc.nrao.edu*. Under current circumstances, however, we cannot consider (re)correlation of any observation already performed.

Until the next version is released, *Sched* will continue to issue a warning message whenever it calculates that the correlator output data rate will exceed 500 kB/s. These messages may be ignored as long as the predicted rate does not also exceed 1000 kB/s.

We do anticipate that some observations will be found not to be correlatable at 1000 kB/s. We will handle as many such cases as possible by correlating channel subsets in multiple passes, and will consult with users where other fall-back measures appear to be necessary.

BACKGROUND:

Since the VLBA correlator began operating nine years ago, selection of correlation parameters has been based on its originally designed maximum output data rate of 500 kB/s. A substantial software and hardware upgrade was begun in 1997, and put most of the required capabilities in place to support higher output rates, but was not completed due to changes of personnel and priorities. The developers believed that the actual output rate achievable would be strongly mode-dependent. Lacking personnel resources to test this dependence adequately, we have been reluctant to raise the operational limit.

In response to numerous user requests, however, we have conducted an ad-hoc testing program, using very brief test correlations with various parameters for regular VLBA observations. We attempted to select those VLBA programs that would best explore the limits of the system, but were limited to whatever observations happened to be available when the correlator queue reached its rare minima. These tests were far from representative, and the expected mode dependence was not detected. However, we believe the results do support a substantial increase in the operational limit at this time.

J. D. Romney

Automated Release of VLBA Tapes

In order to obtain a faster feedback from observations, a quicker turn-around of tapes into the observing pool, and a reduction of the operational load, NRAO is moving toward 'auto-release' of the tapes that are used to record VLBA data. That is, for routine projects only a few will receive the scrutinizing that has been common for all projects until now. If nothing odd has been found in these experiments, and in a weekly monitoring experiment, all similar experiments in that time span will have their tapes released after correlation without human intervention or delay. Note that this will only be the case for routine projects; special projects such as ToO and coordinated observations, as well as odd frequencies and pulsar gating observations will be scrutinized in the same fashion as before. The standard 'sniffer' plots will be made for all projects, using two different reference antennas, and archived for later inspection if needed. More information can be obtained from the undersigned.

L. O. Sjouwerman, G. B. Taylor, M. C. Perley

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	Bands (cm)	Proposals Due
22 May to 12 Jun 2003	18/21 cm, 6 cm, 5 cm ...	01 Feb 2003
23 Oct to 13 Nov 2003	90 cm, 18/21 cm, 6 cm ...	01 Jun 2003
05 Feb to 26 Feb 2004	6, 5, ...	01 Oct 2003

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 JIVE correlator 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 US 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.

B.G. Clark, J. M. Wrobel

VLBA 10th Anniversary Meeting

"Future Directions in High Resolution Astronomy: A Celebration of the 10th Anniversary of the VLBA" was held June 8 - 12, 2003, in Socorro. The meeting had not yet occurred at press time for this edition of the NRAO Newsletter. Highlights will be reported in the next issue.

J. D. Romney

Impact of EVLA Construction on Observers

During the entire VLA Expansion Project we are committed to keeping the VLA observing and producing forefront science. It is expected, however, that there will be some periods when the amount of observing time is reduced, and the average number of antennas available may be fewer than for the nominal VLA. To keep people informed of the impact of the EVLA construction on VLA observations we have created a web site at: *http://www.aoc.nrao.edu/evla/archive/transition/impact.html*. At the web site are short, medium and long term forecasts. Users should consult these forecasts before proposing for time or observing with the VLA.

G.B. Taylor, J. S. Ulvestad

IN GENERAL

View of architects' site model from South-East showing new wing (green roof) and lower parking lot.

The Edgemont Road Building Addition

The NRAO's Charlottesville operations are now divided between (a) Stone Hall, a 24,423 gross sq.ft. building on Edgemont Road built by the University of Virginia to the specifications of the NRAO and leased from the University by NRAO/AUI since 1967, and (b) commercially leased space in the Dynamics Building on Ivy Road.

The scientific, administrative, and Director's offices, the main Library and central computing services are in Stone Hall, while the Dynamics Building has housed the Central Development Laboratory (CDL) and most ALMA-related activity in Charlottesville to date.

The space available to the NRAO in these two buildings is insufficient to meet our needs with the ramp-up of the ALMA Project and the planned relocation of staff from Tucson to Charlottesville. Furthermore, the space in the Dynamics Building is converted office space that is physically unsuitable for much of the high- precision machining and microscopic assembly work required for the CDL's role in developing and building key components for ALMA, the VLA, VLBA, GBT and EVLA.

View of architects' site model from North-East showing new wing (green roof) and lower parking lot.

As part of planning expanded facilities in Charlottesville to support ALMA, the NRAO has worked with the University of Virginia to design a 38,360 gross sq.ft. Addition to Stone Hall. As well as providing greatly increased office space, the Addition contains an expanded Library and conference facilities. The project will also renovate and upgrade infrastructure in the existing building, to bring the entire facility up to modern fire protection and accessibility standards.

The contract for constructing the Stone Hall Addition was awarded to Martin/Horn Inc. of Charlottesville in March 2003. The NRAO Director Fred Lo and AUI President Riccardo Giacconi officiated at a formal ground-breaking ceremony on April 16, 2003. Martin/Horn began to set up operations on the site in late May and construction began in earnest in June. We expect that the NRAO will begin to occupy the Addition in the fourth quarter of 2004.

As anyone who has renovated or added to an occupied building will appreciate, this major construction project means that the existing Edgemont Road facility will be much less hospitable to visitors while the work is under way. The building will be both noisy and crowded and it will be surrounded by the inevitable debris and bustle of construction. Many staff will be displaced from their normal work areas for a while, and physical access to the Library and Auditorium may be restricted at times. Much of the existing parking lot will become a laydown and operations area for the contractor, and temporary parking arrangements will be in place for much of the construction period; parking arrangements may be subject to change at short notice as equipment and material are brought onto the site. Anyone planning to visit Edgemont Road during this construction period should call their contact in Charlottesville ahead of time to find out what unusual conditions they can expect to find during their visit.

The expanded and renovated Edgemont Road building should serve the NRAO and ALMA user communities well for many years to come, so we hope that you will bear with us while the construction work and our transition to the new facility are in progress.

A. H. Bridle

NRAO Image Use Policy

Below you will find the officially approved NRAO Image Use Policy. The question of an image use policy arose out of discussions concerning the relatively new NRAO Image Gallery (*http://wwwmain.cv.nrao.edu/image-gallery/php/level1.php*). However, the Image Use Policy below applies to all NRAO image use, not only the Image Gallery. Although this is a use policy, as the introductory statement indicates, the intent is to encourage development and distribution of radio astronomy images. If you have an appropriate image please consider submitting to the NRAO Image Gallery through the submission tool available at *http://www.nrao.edu/imagegallery/php/ext_sub.shtml.*

Users of NRAO telescopes have an inherent obligation to make images derived from NRAO data available for educational, public information, and research purposes via the NRAO in a timely manner. Images, electronic or otherwise (including captions), created, authored and/or prepared by the NRAO/AUI and the NRAO staff are copyrighted in content, presentation, and intellectual or creative origin. All such materials are considered intellectual property and are intended for use for educational, public information, and research purposes. Use of NRAO/AUI names and/or logos in publicity, promotion, or advertising is prohibited without prior written consent of NRAO/AUI. Commercial use will be considered on a case-by-case basis. Use of NRAO/AUI images constitutes acceptance of the guidelines listed:

I. NRAO/AUI IMAGES USE

The NRAO encourages the use of its images, electronically or in other formats, for educational and public information purposes. The use of such images must not imply endorsement by the NRAO/AUI/NSF of organizations, products, or services using the images.

A. Usage Categories

Three general categories are defined for the use of NRAO images: Educational/ Public Information, Personal (Not for Profit), and Commercial.

1. Educational / Research Use: The NRAO allows reproduction, authorship of derivative works, and other transformations of the original work strictly for educational, public information, and research purposes without further permission, subject to the General Conditions section listed below. If a recognizable person appears in an image, use may infringe a right of privacy or publicity, and permission shall be separately obtained from the recognizable person. For other non-commercial uses, permission shall be obtained from the NRAO/AUI.

2. Personal, Not-for-Profit Use: The NRAO allows reproduction, authorship of derivative works, and other transformations of the original work strictly for personal, non-profit / non-commercial / non-retail use without further permission, subject to the General Conditions section listed below. Some examples of personal, non-profit/non-commercial/non-retail uses are downloading

images for personal posters, screensavers, or as gifts for friends and relatives.

3. Commercial Use: Written permission must be obtained from the copyright owner, the NRAO/AUI and/or other listed copyright owners, prior to commercial use. The NRAO will work with vendors on a case-by-case basis to establish appropriate permissions for use, which in some cases may involve a fee or royalty agreement. Even when permission to use an image is granted, the prohibition against endorsement by the NRAO/AUI/NSF of organizations, products, or services still applies. If a recognizable person appears in an image, use for commercial purposes may infringe a right of privacy or publicity, and permission shall be separately obtained from the recognizable person. Commercial vendors are required to submit a description of the intended use of the images to the contact address below for verification of appropriate use.

B. Credit and Copyright Statements

Any use of NRAO images shall include one of the following credit statements:

- "This image was generated with data from telescopes of the National Radio Astronomy Observatory, a National Science Foundation Facility, managed by Associated Universities. Inc.",
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- "NRAO / AUI / NSF".

Additional credit lines may be required for images that are copyrighted by individuals or other organizations. In such cases use the copyright specified and contact the individual/organization if questions arise.

II. GENERAL CONDITIONS

NRAO/AUI images may NOT be used to constitute, state or imply the endorsement by NRAO/AUI, the NSF or any NRAO/AUI employee of a commercial product, process, service, theory, or activity.

The NRAO/AUI shall be acknowledged as the source of its materials, products, and technologies.

The NRAO/AUI shall in no way be liable for any costs, expenses, claims or demands arising out of use of NRAO/AUI images by a recipient or a recipient's distributees.

NRAO/AUI personnel are not authorized to sign "hold harmless" statements or documents granting exclusive rights.

AUI has agreed that if it or anyone else owns a copyright which is produced by AUI or its employees in the performance of work under AUI's Cooperative Agreement with NSF, the Federal Government will have a non-exclusive, non-transferable, irrevocable, royalty-free license to exercise or have exercised for or on behalf of the United States throughout the world all exclusive rights provided by the copyright.

The NRAO is an equal opportunity, affirmative action employer and will not use images to discriminate against any protected employment class.

III. CONTACT

For further information or assistance, please contact:
Public Information (*info@nrao.edu*)
National Radio Astronomy Observatory
520 Edgemont Rd.
Charlottesville, VA 22903

L. T. Shapiro

Donald C. Backer Selected for the 2003 Jansky Lectureship

Associated Universities, Inc. (AUI) and the National Radio Astronomy Observatory (NRAO) are pleased to announce that Donald C. Backer, professor of astronomy, University of California at Berkeley, will present the thirty-eighth annual Karl G. Jansky Lectureship. Backer is being honored for his seminal contributions to the discovery of millisecond pulsars.

The Jansky Lectureship is awarded each year by the Trustees of Associated Universities, Inc. to recognize outstanding contributions to the advancement of astronomy. The lectureship is named after Karl G. Jansky, the AT&T Bell Labs engineer who in 1932 first discovered natural radio waves emanating from space.

Backer's interests include a variety of compact and energetic objects in the Milky Way and beyond. Among these are pulsars, the nucleus of the Milky Way, and the nuclei of other galaxies and quasars. His research employs large radio telescopes, and emphasizes the technique of high-resolution radio interferometry.

His work on millisecond pulsars is focused on the consequences of the discovery in 1982 of a pulsar spinning at 642 Hz, which is near the centrifugal limit for neutron stars. Backer and his colleagues continue to monitor this pulsar, and to search for other millisecond-period pulsars. The timing measurements of these pulsars have an accuracy that rivals the best atomic time standards on Earth. These measurements also help astronomers to place stringent limits on the magnitude of the background of gravitational radiation left over from the Big Bang.

Backer also oversaw the development of the Berkeley-Caltech Pulsar Machine, which has been used on the National Science Foundation's Robert C. Byrd Green Bank Telescope to detect new pulsars in globular cluster M62, as well as the youngest radio pulsar ever detected in supernova remnant 3C58.

Backer will deliver the Jansky Lecture at the various NRAO sites later this year. Information when confirmed will be available on the NRAO website *www.nrao.edu/jansky.*

C. E. Blue

2003 NRAO Summer Students

By the time this newsletter hits the stands, the 2003 summer student class should have reported to their assigned NRAO sites. The 2003 class consists of 27 students: four graduate students supported by the NRAO Graduate Summer Student Program, eight undergraduate students or graduating seniors supported by the NRAO Undergraduate Summer Student Program, and 15 undergraduate students supported by the National Science Foundation Program "Research Experience for Undergraduates" (REU). Twelve students are assigned to Socorro, seven to Charlottesville, six to Green Bank, and two to Tucson. These 27 students were chosen from 151 applicants.

During their 10-12 week summer internship, the students will work with an NRAO advisor on a project in the advisors area of expertise. Besides their summer research projects, the students will attend a lecture series and go on field trips to other observatories. Students will collaborate on observational projects using NRAO and possibly other instruments while participating in the colloquia, seminars and other events at their particular site.

The accompanying table lists the names and schools of this years NRAO summer students. More detailed descriptions of the student projects are available at *http://www.nrao.edu/students/NRAOstudents_projects03.shtml*. Details on these and all NRAO student programs are available at *http://www.nrao.edu/students/*.

Student	School	Project
Justin Atchison	Louisiana Tech University	Laser Metrology of the GBT
Tiffany Borders	Sonoma State University	VLBA Observations of the Protostar G192.16
Katie Chynoweth	The Colorado College	Searching for Radio-Quiet BL Lacs
Chris Clearfield	Harvard	The Polarization Response of the VLA Antennas
Richard Cool	University of Wyoming	VLBA/VSOP Polarimetry of Gamma-ray Blazars
Jessica Cooper	University of Arizona	A Control System for the ALMA Test Facility
Andrew Cowan	University of Iowa	Export Formats for Data from the GBT
Regina Flores	Barnard College	The Contamination of the CMB by Radio Sources
Rohit Gawande	Chalmers University	GBT Ka-Band Engineering
Aaron Geller	University of Iowa	Turbulence in the Galactic Magnetic Field
Alexander Grichener	Tufts University	ALMA Band 6 SIS Mixer Test System
Catherine Kaleida	University of Georgia	The DR21(OH) Star Formation Region
John Kelly	University of Virginia	Projection Effects in Active Galactic Nuclei
Emily Landes	UC Berkeley	HI Absorption Studies of Compact Radio Sources
Chun Ly	University of Arizona	VLBA 327 MHz Imaging of Radio Galaxies
Mehreen Mahmud	Whittier College	Superluminal Motions in Quasars and AGN
Holly Maness	Grinnell College	VLBA Observations of Compact Symmetric Objects
Jodie Martin	University of Virginia	Ellipticals with Anomalous Light Profiles
Itziar Monsalvo	Universidad Autonoma de Madrid	CCS and Ammonia in Class 0 Protostars
Miranda Nordhaus	Rensselaer Polytechnic Institute	The Structure of the Lynds 1498
Chaitali Parashare	Chalmers University	The Solar Burst Monitoring Station
Urvashi Rao Venkata	UCSD	Imaging Algorithms for Radio Astronomy
Christine Roark	University of Iowa	The UV Spectrum of the Flare Star EV Lac
Kate Rubin	Yale University	Modeling the Interacting Galaxies NGC5713/19
Alicia Soderberg	Caltech	The Connection Between Supernovae and GRBs
Laura Spitler	University of Iowa	Black Hole Binaries & Microquasars
Richard Thomsen	Duke University	The Design and Test of LO sources for ALMA
Shannon Wells	Columbus State University	A Search for Active Nuclei in Massive LSBs
Lauren Wye	University of Virginia	A Cosmic Ray Radio Frequency Burst Detector

J. Hibbard, H. A. Wootten, G. Taylor, R. Maddalena, J. Mangum

Opportunities for Predoctoral Support at the NRAO

The NRAO predoctoral program supports a number of graduate students working toward their doctoral degree. Full support is provided for a period of up to 24 months. The student works at the NRAO under the supervision of a member of the scientific staff. Several positions will become available in autumn, 2003. There are three requirements: 1) the student must be afilliated with a PhD granting academic institution in the United States; 2) the student must be recognized as a bona fide doctoral candidate by their home institution - that is, they must have completed their course work and passed their qualifying exam; 3) the thesis work of the student must be supervised by a member of the NRAO scientific staff, or jointly supervised by a member of the NRAO scientific staff and a faculty member at the student's home institution.

For a student to be considered for an NRAO predoctoral appointment, the student must arrange for a letter of nomination from the NRAO staff member with whom he/she wishes to work, provide a curriculum vita, and a brief written description of the research program the student wishes to undertake.

For consideration for the coming academic year, please submit material by September 1 to:

Tim Bastian
NRAO
520 Edgemont Rd
Charlottesville, VA 22903

T. S. Bastian

RET at NRAO Summer of 2003

The Research Experience for Teachers (RET) Program is headed for a good summer at both Green Bank and Socorro. We will have two teachers at Green Bank and one at Socorro.

John Ciccarelli teaches at the George Washington Carver High School for Science & Engineering, a magnet school in Philadelphia, PA. John was at Green Bank last year and on his school's website *http://www.phila.k12.pa.us/schools/carver/* there is a picture of him on the GBT dish. He will be working with Ron Maddalena on Green Bank Telescope Commissioning Activities.

Robert Sparks is on the faculty at The Prairie School in Racine, WI. The Prairie School is an independent school for grades 3-12 and Rob teaches Upper School science. He will be working with Frank Ghigo on Observing and Analyzing Green Bank Telescope Data.

Matt Williams teaches at Belen High School in Belen, NM. He will be working with Mark Claussen on VLA and VLBA Observations of Water Masers around Young Stellar Objects. This will be the second year for the RET Program in Socorro. For more information on the NRAO's RET Program see *http://www.gb.nrao.edu/epo/ret.html*.

L. T. Shapiro

Reminder for Student Observers and Their Advisors

Students whose dissertations include observations made with NRAO instruments are expected to donate copies of their theses to the NRAO library.

We will place the copies you provide in the appropriate NRAO libraries for use by staff and visitors. We request that you send two or more copies, one for the main library in Charlottesville and one for the library at the site where data were taken. If you wish to provide up to four copies, we will add them to the other site library collections.

Paper copies of theses are preferred, and the library will arrange for binding of any unbound paper copies. We will also accept theses on a CD in PDF, Postscript, or WordPerfect document formats.

Please mail all copies of your thesis to:

Library
National Radio Astronomy Observatory
520 Edgemont Rd.
Charlottesville, VA 22903-2475 USA

Address questions to A. K. Robertson, *(library@nrao.edu)*.

A. K. Robertson

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.

Editor: Barry Turner *(bturner@nrao.edu)*
Science Editor: Juan Uson *(juson@nrao.edu)*
Assistant Editor: Sheila Marks
Layout and Design: Patricia Smiley

If you have an interesting new result obtained using NRAO telescopes that could be featured in this section of the NRAO Newsletter*, please contact Juan Uson at* juson@nrao.edu. *We particularly encourage Ph.D. students to describe their thesis work.*

NEW RESULTS

A Molecular Einstein Ring: Imaging a Starburst in the Host Galaxy of a Luminous, High Redshift Quasar

Establishing a link between galaxy formation and massive black hole formation has become paramount for observational astronomy since the discovery of the correlation between black hole mass and stellar bulge mass in nearby galaxies. Unfortunately, arguments in favor of coeval starbursts and major massive black hole accretion events (i.e. luminous quasars), in high redshift galaxies have been strictly circumstantial, such as radio-through-FIR SEDs consistent with star formation, and the detection of large molecular gas masses.

The QSO PSS 2322+1944 at z = 4.12 is among the most IR-luminous high redshift QSOs, with an apparent FIR luminosity of 3×10^{13} $L_{\odot}$. Optical imaging and spectroscopy shows that 2322+1944 is a double source, with two essentially identical spectrum components separated by about 1.5", indicating strong gravitational lensing by an intervening galaxy. PSS 2322+1944 is also the brightest known CO line emitting source at z > 4, with an implied molecular gas mass of 2×10^{11} $M_{\odot}$ (not corrected for lens magnification). Non-thermal (synchrotron) radio continuum emission from PSS 2322+1944 was detected at 1.4 GHz, and the rest frame radio-through-IR spectral energy distribution of PSS 2322+1944 matches closely that of the prototype nuclear starburst galaxy M82. Overall, the properties of PSS 2322+1944 make it the best candidate for very active star formation in the host galaxy of a high redshift QSO.

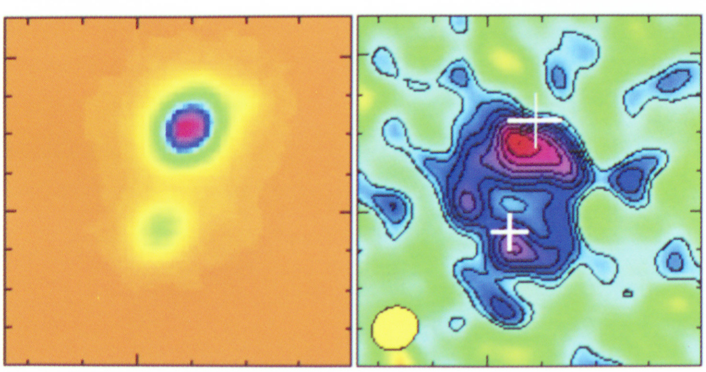


Figure 1. The left panel shows the Keck K band image of PSS 2322+1944, and the right panel shows the VLA image of the total CO 2-1 emission (rest-frame frequency = 230.538 GHz) at a resolution of 0.6" at the central observing frequency of 45.035 GHz. The contour levels are a geometric progression in square-root two starting at 0.12 mJy/beam. The crosses show the positions of the optical QSOs, and the cross sizes represent the relative astrometric error. Tick-marks are separated by 0.5".

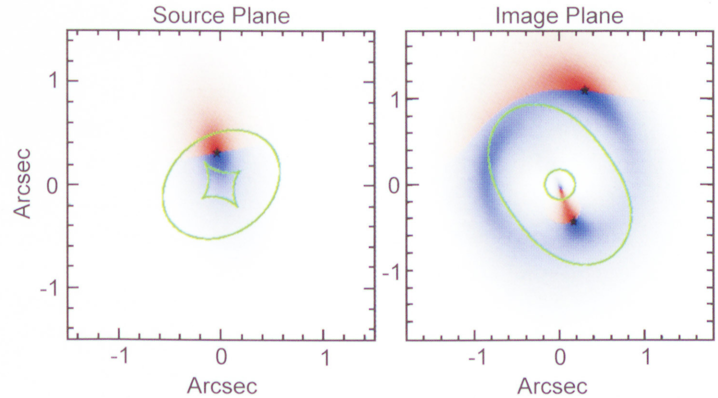


Figure 2. A gravitational lens model for the CO emission in PSS 2322+1944. The left-hand panel presents the source-plane distribution, corresponding to the true morphology of the system (i.e. undistorted by lensing). The image-plane distribution is presented in the right hand panel, corresponding to the observed morphology after being distorted by the gravitational lens. The point-like QSO is represented by a five-point star in both panels. The solid lines are the caustics and critical lines in the source and image planes, respectively. The CO emission is modeled as an inclined disk around the QSO, with the north and south parts of the disk being color-coded red and blue, respectively, corresponding to different velocity regions on opposite sides of the QSO.

High-resolution images of the molecular line and radio continuum emission from PSS 2322+1944 have established, for the first time, a clear link between a starburst and an AGN in a luminous, high-redshift QSO. The VLA was used to observe the CO 2-1 transition, which redshifts to 44 GHz, and the 1.4 GHz continuum emission. These observations reveal an Einstein ring with a diameter of 1.5", both for the CO emission and the radio continuum emission

The telescopic effect of strong lensing provides the unique opportunity to study the gas distribution on sub-kpc scales in the parent galaxy of this quasar. These results are best modeled as a star forming disk surrounding the QSO nucleus with a radius of 2 kpc.

The implied massive star formation rate is 900 $M_{\odot}$/yr. At this rate a substantial fraction of the stars in a large elliptical galaxy could form on a dynamical time scale of 10^8 years. The observation of active star formation in the host galaxy of a high-redshift QSO supports the hypothesis of coeval formation of supermassive black holes and stars in primeval spheroidal galaxies.

C. L. Carilli (NRAO)

Reference: Carilli et al. 2003, Science, 300, 773

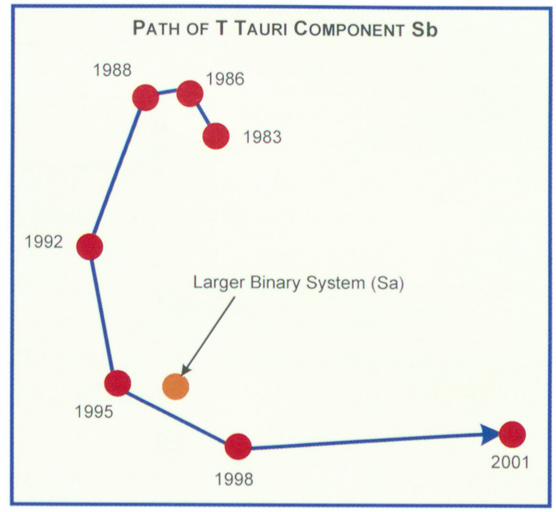
Ejection in Taurus?

Over the last two decades, the Very Large Array has been used to observe in several epochs many of the nearby regions of low-mass star formation, like Taurus or Ophiuchus. In these observations, the members of binary and even multiple systems of embedded young stars are sometimes detected as compact radio sources. The detection is believed to be the result of free-free emission from the stellar outflows or of gyrosynchrotron emission from active magnetospheres. Our group has started to make use of this unique database to search for proper motions in these young multiple systems that are detectable in the radio. Up to now, we have studied in detail five systems. In three of them (L1527, L1551 IRS5, and YLW 15) we found proper motions that imply gravitationally-bound orbits and total masses for the systems in the range of 0.5 to 2 solar masses (Loinard et al. 2002, Rodríguez et al. 2003, Curiel et al. 2003). This is an important result on its own: simply, there is no other techique available to estimate the masses of extremely obscured young stars. In another source, IRAS 16293-2422 (Loinard 2002), it is still unclear if the large relative motions observed reflect an orbital path in a bound system, or unbound motions possibly associated with high velocity ejecta.

In an attempt to check our techniques, we decided to include in our analysis a fifth object: T Tauri, the star that gives its name to the class of T Tau stars. There are optical and near-infrared results for T Tau that were expected to allow a comparison with the radio results. T Tau is known to consist of at least three components: T Tau N (the well-known bright variable star) and T Tau Sa and Sb (an infrared binary system some 0.7 arcsec to the south of T Tau N). The VLA detects T Tau N and T Tau Sb; T Tau Sa has never been detected in the radio. The VLA archives included centimeter data of good quality and high angular resolution from 1982 to 2001.

As we advanced systematically in time we found that, besides the proper motion of the whole system with respect to the Sun, we could clearly measure the motion of T Tau Sb with respect to T Tau Sa. Our analysis of the radio data was complemented with recent speckle and adaptive optics near-infrared images that allowed us to determine the position of T Tau Sb with respect to T Tau Sa.

The results of our analysis (Loinard et al. 2003) are shown schematically in Figure 1. With respect to T Tau Sa, T Tau Sb described from 1983 to 1995 what appears to be a bound, elliptical orbit that followed Kepler's second law. However, between 1995 and 1998, T Tau Sb derailed from its previous orbit and started to move rapidly (20 km/s) to the west. Remarkably, this change of orbit happened at the closest approach between T Tau Sa and T Tau Sb. Our interpretation is that T Tau Sa is a tight binary system that in a three-body interaction imparted some of its orbital energy to T Tau Sb, casting the latter away.



Schematic description of the orbit of T Tau Sb with respect to T Tau Sa. From 1983 to 1995 the notion can be described as a bound, elliptical orbit. However, between 1995 and 1998 T Tau Sb appears to have changed its orbit as it is ejected from the system. Since this can only happen in an interaction between 3 or more bodies, it is proposed that T Tau Sa is a close binary.

One problem with this interpretation is the low probability of witnessing such event. Independently, a group from the US Naval Observatory had analyzed the data and proposed that the orbit of T Tau Sb is bound (Johnston et al. 2003), although the total mass required for this, about 5 solar masses, seems too large for the known luminosity of the system. The issue should be settled in the next few years as we see the motion of T Tau Sb progress with time.

L. F. Rodríguez and L. Loinard
(Instituto de Astronomia, UNAM, Mexico)

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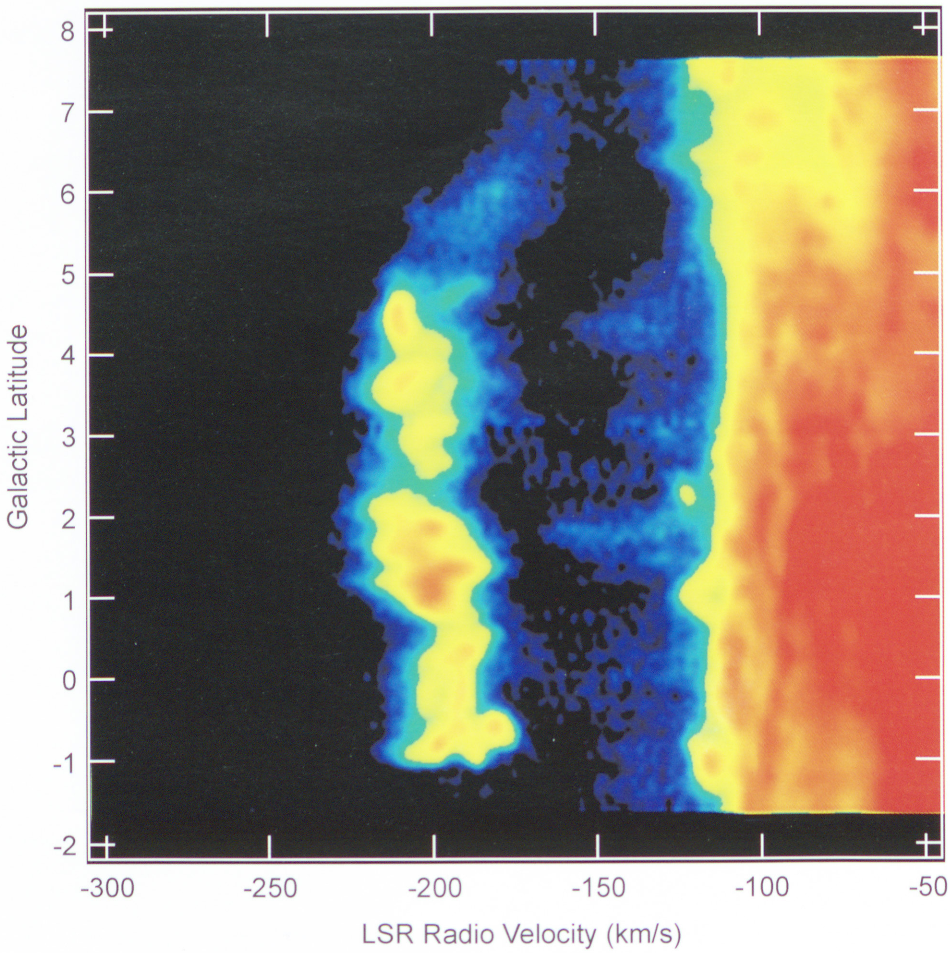
High-Velocity Cloud Complex H: A New Dwarf Companion to the Milky Way?



GBT measurements of the 21cm emission from Complex H along a cut in galactic latitude at constant longitude. This "slit-spectrum" shows the core of the complex, which consists of cool HI clouds embedded in a hotter medium, at Galactic latitudes < 5 degrees and V_{LSR} = −200 km/s. HI from the galactic disk in normal rotation appears on the right side of the figure. The data also show that Complex H has a diffuse tail of turbulent HI at b > 5 degrees which shifts in velocity back toward normal disk HI. This direction also shows diffuse HI at velocities between the complex and the normal disk, evidence that the Complex is interacting with the Galaxy.

The high-velocity HI cloud called Complex H covers more than 100 square degrees on the sky. Like other high-velocity HI clouds, its velocity cannot be explained by normal Galactic rotation. However, unlike most other high-velocity clouds, it lies in the Galactic plane. Recent observations of Complex H with the GBT show that it consists of two quite distinct parts: a core, which contains compact clouds of narrow-line HI, and a more diffuse, extended region characterized by broad HI lines with velocities that span the range from the anomalous velocity of the core all the way to velocities permitted by normal Galactic rotation. This suggests that the diffuse component might arise from material swept off Complex H in its interaction with the Galactic halo, making Complex H a dramatic example of a "head-tail" high-velocity HI cloud.

The GBT data lead to a detailed model for the kinematics of the core of the Complex. For an object near the Galactic plane, $dV_{LSR}/db = V_Z$: the change of the projected V_{LSR} with latitude gives the component of vertical velocity. The gradient measured with the GBT in the area where Complex H crosses the Galactic plane, −3 km/s per degree of latitude, shows that it must be moving toward the South Galactic Pole with a vertical velocity of −170 km/s. Evidence from many sources suggests that the Galaxy has a rotation curve which is approximately constant for several hundred kpc. If Complex H is in a circular orbit with a total orbital velocity of 220 km/s, both the average V_{LSR} of the core as well as its gradient, follow naturally if the orbit is retrograde and inclined about 45 degrees to the Galactic plane. Such an orbit is consistent with the overall morphology of the object, especially the location of the diffuse, presumably decellerated gas.

Complex H thus appears to be a previously unrecognized satellite of the Milky Way, on an inclined, retrograde orbit about 33 kpc from the Galactic Center with an orbital period of about 1 Gyr. At a present distance of 27 kpc from the Sun, it contains more than 6×10^6 $M_\odot$ of HI and its size is at least 10 × 5 kpc, similar to the size of some dwarf galaxies. The extensive tail of decelerated gas shows that it is in the process of being destroyed by its interaction with the Milky Way halo. Further observations with the GBT may reveal the interaction in more detail, allowing the orbit to be refined, and giving information on conditions in the halo gas with which it is interacting. A search along the predicted past trajectory may reveal more debris, and perhaps illuminate the history of this curious object.

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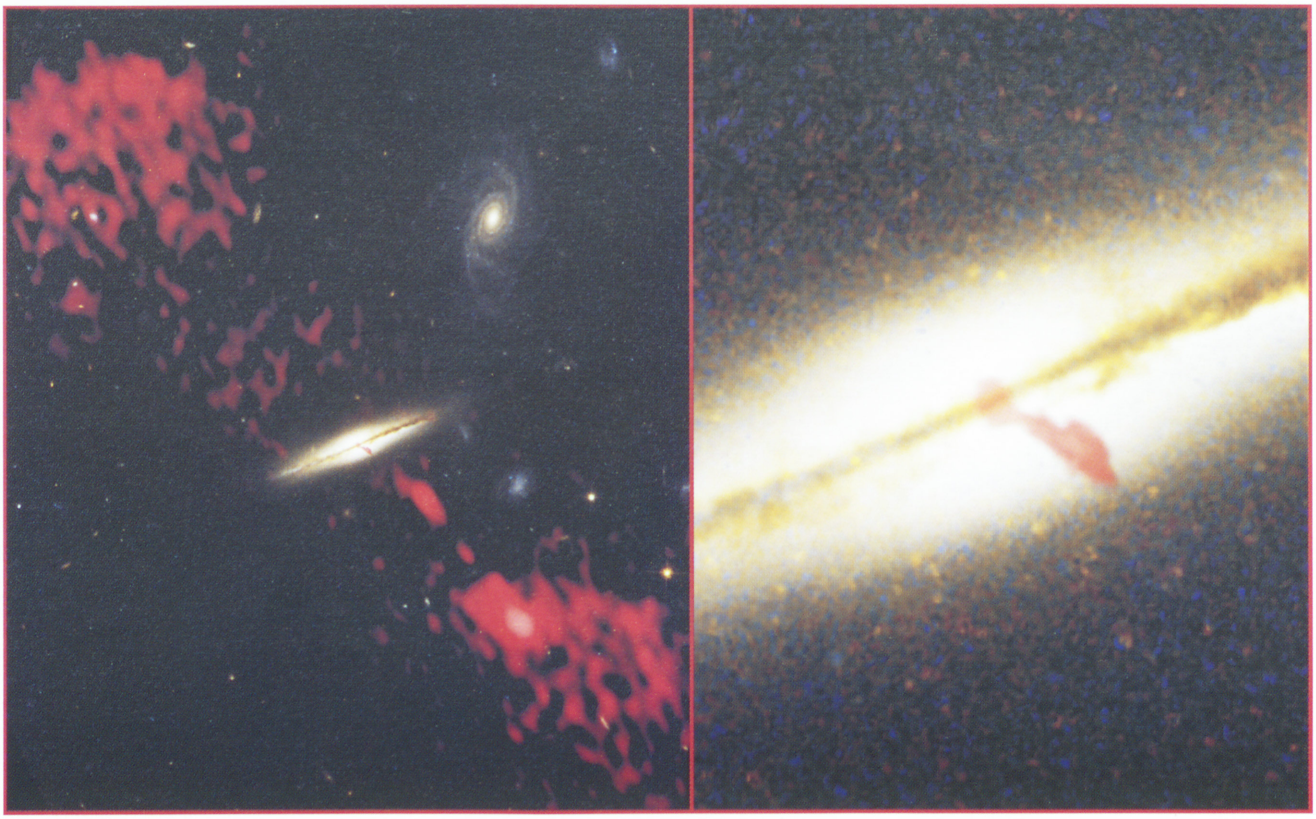
The Radio Galaxy 0313-192: A Giant Radio Source from the Wrong Kind of Galaxy



Combined HST and VLA image ofthe galaxy 0313-192. Optical HST image shows the galaxy edge-on; VLA image, shown in red, reveals giant jet of speeding particles.

Since optical identifications of radio galaxies became reliable more than 50 years ago, one of the consistent results is that radio galaxies with very extensive jets and lobes always are associated with early type galaxies, almost always ellipticals. Examples have shown up from time-to-time which appeared to show a classical double associated with a spiral but most of these are not confirmed when one examines the case closely. One such candidate example, 0313-192, was found by us in Abell 428 while surveying rich clusters with the VLA. However, this example has not gone away as we have looked at it more and more closely.

In the figure we show two displays of the radio image overlaid on a recent HST ACS image of the system. The disk galaxy is almost exactly edge on and shows a prominent dust lane along the midplane. The VLA 20 cm image (in red) shows a one-sided jet and two diffuse radio lobes with a total extent in excess of 200 kpc. The core source (which has been mostly subtracted from this image) has a rising radio spectrum from 20 cm to 7 mm. The total radio luminosity is about 10^{24} W/Hz, consistent with other FR I radio galaxies. The core also has a deep HI absorption line, consistent with an optical depth of 2-3, which is very similar to our view of our own galactic center. Thus, we seem to be viewing an edge-on spiral perhaps much like our own, although it would appear to be a luminous AGN if viewed from another angle.

The jet and the lobes extend well beyond the optical limits of the galaxy. The fact that we see such a system may be due to its environment. Abell 428 turns out not to be a centrally condensed cluster but conglomeration of small groups. Thus, the external density may be just right not to strip the disk galaxy and at the same time to provide a dense enough external medium to confine the relativistic plasma and magnetic field. Similar objects would not be able to maintain the collimation structure that we see here if they were located in a low-density environment. Thus, 0313-192 suggests that the extreme activity that we associate with elliptical galaxies is not unique to that Hubble type; but is determined instead by the surrounding environment.

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Bill Keel (Alabama)
Mike Ledlow (Gemini)

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Mapping the Sky with WMAP

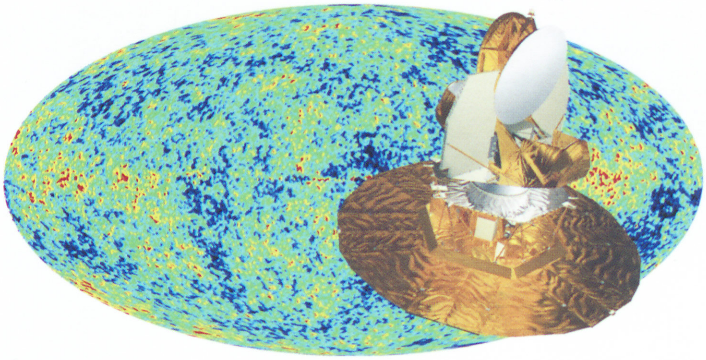

Figure 1. A picture of the WMAP satellite superimposed on WMAP's full sky map of the Cosmic Microwave Background. The data have been combined in a manner that suppresses the galactic contribution which would otherwise appear as a bright stripe across the center of the map.

On June 30, 2001, the 286th Delta was launched from Cape Canaveral's pad 17B. Five minutes after launch, the Boeing Delta II 7425 cutoff the first-stage engine, jettisoned the fairing, and the payload was exposed to space. Signals from the padload were relayed to ground via TDRS-W satellite for processing at the Goddard Space Flight Center. The solar array panels were deployed and the spacecraft oriented itself along the Sun-line simultaneously producing the necessary electrical power and shielding its scientific package from solar radiation. As the instrument passively cooled to its operational temperature, multiple NRAO amplifiers stared into the depths of space and began measuring the remnant radiation from the birth of the Universe. The Wilkinson Microwave Anisotropy Probe (WMAP) had flawlessly completed the first steps in its mission.

Analyses of these measurements reveal that the Universe is spatially flat and that the expansion is accelerating, consistent with supernovae and large scale structure data. The universe contains roughly 4.5 percent baryons, 22.5 percent cold dark matter of unknown composition, and 73 percent dark energy/pressure. The best fit age is 13.7 ± 0.2 Gyr. From the WMAP measurement of polarization, one deduces that the formation of the first stars occurred ~200 Myr after the big bang. The first year data is available at *http://lambda.gsfc.nasa.gov.*

To make full sky maps of the cosmic microwave background radiation (CMB) and determine the underlying cosmology of our Universe requires verifiable accuracy and unprecedented control over systematic effects. The instrument employs back-to-back offset Gregorian telescopes which produce 0.93, 0.78, 0.58, 0.35 and 0.23 degree beams at 23, 33, 41, 61 and 94 GHz respectively. This compact optical design allows efficient placement of the feeds and radiometers while allowing control over optical spill. Differential receivers are passively cooled to ~90 K to achieve sensitivity. This instrument configuration allows precise measurement of the CMB temperature differences and evaluation of foreground emission from dust, synchrotron, bremstralhlung, and point sources.

At the heart of the instrument are 80 High Electron Mobility Transistor (HEMT) low noise amplifiers produced by the NRAO Central Development Laboratory. At the time of the WMAP proposal, the state of the art in millimeter wave LNAs was an E-band amplifier developed by M. Pospieszalski for the 86 GHz VLBI receiver which used Hughes InP devices. This realization served as a proof of principle which enabled the mission. Considerable effort was required to realize space qualified amplifier designs which could be reliably produced in quantity. Clean room, bonding, and test facilities were put in place. Amplifier designs were qualified for thermal stress, vibration, outgassing, RF/ionizing radiation exposure, and extended life. Prior to delivery to Princeton University for integration the amplifiers were tested for phase, gain, noise, and stability at flight extremes. This attention to detail by the CDL team (N. Bailey, D. Boyd, T. Boyd, C. Burgess, D. Dillon, R. Harris, N. Horner, F. Johnson, W. Lakatosh, P. Mann, A. Marshall, G. Morris, M. Pospieszalski, V. Summers, D. Thacker, J. Webber, M. Wharam, W. Wireman, and others) proved invaluable in adapting these devices to achieve WMAP's scientific goals. The amplifiers have performed as designed and continue to take data.

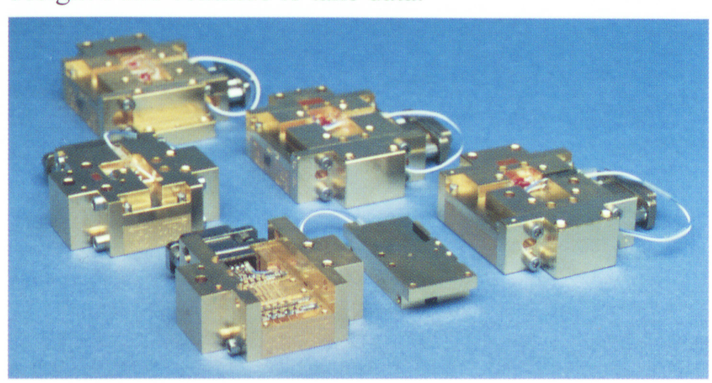

Figure 2. NRAO WMAP Amplifiers. To learn more, see http://www.nrao.edu/engineering/amplifiers.shtml.

Ed Wollack (NASA/GSFC)

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