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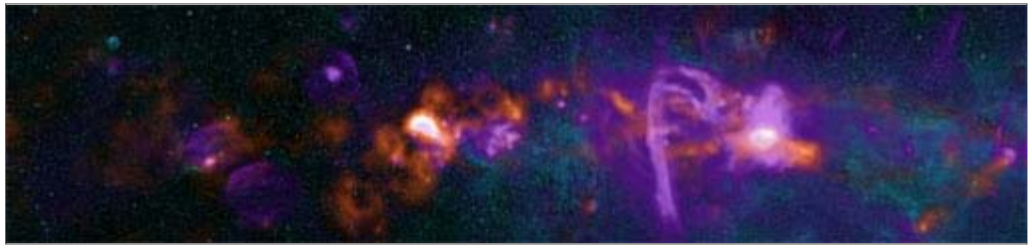

The Galactic Center and the surrounding Central Molecular Zone comprise the most active star formation region in the Milky Way. Credit: Adam Ginsburg and John Bally (Univ of Colorado - Boulder), Farhad Yusef-Zadeh (Northwestern), Bolocam Galactic Plane Survey team; GLIMPSE II team.

Upcoming Events

NAIC-NRAO School on Single-Dish Radio Astronomy
July 12-18, 2009 | Arecibo Observatory, Puerto Rico

VLBA Astrometry Workshop
July 21-23, 2009 | Socorro, NM

XXVIIth IAU General Assembly
August 3-14, 2009 | Rio de Janeiro, Brazil

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

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

The 1.1 mm Bolocam Galactic Plane Survey

John Bally (Univ. of Colorado)

The Bolocam Galactic Plane Survey (BGPS) covers 170 square degrees of the northern Galactic Plane at a wavelength of 1.1 mm in the dust continuum. The survey was obtained with the 144 element Bolocam camera on the 10.4 meter diameter radio telescope at the Caltech Submillimeter Observatory.

The survey team is pleased to announce the release of the survey data and source catalog through the NASA/IPAC Infrared Science Archive (IRSA) at the Infrared Processing and Analysis Center (IPAC):

http://irsa.ipac.caltech.edu/data/BOLOCAM_GPS/

Millimeter-wavelength thermal dust emission traces the densest molecular gas most directly associated with the birth of stars and star clusters. BGPS probes a range of scales from cores in nearby clouds destined to produce individual stars and more distant clumps which may give birth to massive stars and star clusters. It will enable the investigation of the initial conditions of massive star and cluster formation without the biases inherent in source selection based on embedded infrared sources, HII regions, masers, or other signposts of on-going star formation.

The BGPS images and catalog provide an important database for future sub/millimeter observations. At wavelengths around 1 cm, the GBT has the same beam size as the CSO, making it an ideal instrument with which to probe the temperature and density of BGPS clumps using the 1.3 cm ammonia transitions. Spectral line, continuum, and polarization observations of BGPS clumps with the GBT will probe their grain properties, chemistry, and magnetic fields.

BGPS will serve as a finder chart for studies with ALMA and EVLA in the near future. High angular resolution line and continuum interferometry will determine when and how massive clumps fragment into star-forming cores, trace the flows of matter from molecular clouds onto clumps, cores, circumstellar disks, forming stars and planetary systems, and probe the feedback and self-regulation of star and cluster formation. ALMA and EVLA spectral line observations will measure velocity fields and trace chemical evolution. Continuum observations will identify young stars and probe the evolution of their ionizing radiation and resulting HII regions. The roughly 8400 clumps identified in BGPS will enable the investigations of the dependence of clump properties over the full range of Galactic environments from the Galactic center to the outer galaxy accessible in the anti-center direction.

The BGPS with an effective resolution of 33" FWHM provides contiguous coverage from $-10.5 \leq l \leq 90.5$, $|b| \leq 0.5$ and is augmented with increased latitude coverage (to +/- 1.5 degrees) toward the Cygnus X region near l~80 and in four strips at l = 3, 15, 30, and 31. The area coverage of this section of BGPS is 133 square degrees. In addition, four targeted regions in the outer Galaxy were observed including IC1396 (9 square degrees), the l = 111 complex containing NGC7538 (4 square degrees), the W3/4/5 complex (18 square degrees), and Gem OB1 (6 square degrees). The survey has detected approximately 8400 clumps to an rms noise level ranging from 30 to 60 mJy/beam.

The Northern hemisphere BGPS compliments the southern hemisphere ATLASGAL survey at the APEX sub-mm telescope in Chile (Schuller et al. 2009) and covers most of the fields soon to be observed by the Hi-GAL consortium using the Herschel Space Observatory.

The data release includes fully reduced FITS map files, noise maps, and a catalog of sources produced by a custom catalog algorithm. BGPS sources are usually extended asymmetric structures, so the catalog reports source positions based on the maximum of emission in each source. The maxima are likely the best targets for follow-up observations of these millimeter continuum sources. Source centroids, sizes, and flux densities are

also reported. Papers describing the data acquisition, reduction, and catalog production have been submitted to the ApJ (Aguirre et al. 2009; Rosolowsky et al. 2009) and are available from the IPAC site.

University of Colorado graduate student Adam Ginsburg used the BGPS data covering the Galactic center, combined with the Spitzer / IRAC, and VLA 20 cm radio continuum images to create a color composite which won the 2008 AUI/NRAO Image Contest and was featured in the 2009 AAS calendar.

The BGPS project is supported by the National Science Foundation through NSF grants AST-0708403 (U.C. Boulder) and AST-0607793 (U. Texas). Observing runs were partially supported by travel funds provided by NRAO.

Student Observing Support Awards

Jeff Mangum

The NRAO Student Observing Support (SOS) Committee met in January and May 2009 to discuss the proposals that were submitted during the previous trimesters. The SOS Committee (composed of five faculty members from U.S. universities) discussed the science case and student support application of each proposal. Listed below are those that were selected to receive funding. Complete information on the Student Observing Support program is available at **http://wiki.gb.nrao.edu/bin/view/Observing/NRAOStudentSupportProgram**.

SOS funds were awarded to these proposals that were submitted during the 09A (October 1, 2008) deadline:

- Shea Brown (University of Minnesota, Supervisor: Lawrence Rudnick) was awarded $17,355 for work related to proposal GBT09A-008, **"Relativistic Probes of the WHIM"**
- Katie Chynoweth (Vanderbilt University, Supervisor: Kelly Holley-Bockelmann) was awarded $19,000 for work related to proposal GBT09A-046, **"A Search for Faint Extended HI in Nearby Galaxy Groups"**
- Benjamin Zeiger (University of Colorado, Supervisor: Jeremy Darling) was awarded $20,500 for work related to proposal GBT09A-064, **"A Spectral Survey of an Opaque Atmospheric Window"**
- Miranda Nordhaus (University of Texas, Supervisor: Neal Evans) was awarded $35,000 for work related to proposal GBT09A-080, **"NH3 in Dense Cloud Cores Selected from the 1.1 mm Continuum BGPS"**
- Greg Ziemann (University of California, Davis, Supervisor: Robert Becker) was awarded $35,000 for work related to proposal AB1314 (VLA09A-106), **"A FIRST Complement to SDSS-III"**

SOS funds were awarded to these proposals that were submitted during the 09B (February 1, 2009) deadline:

- Loren Anderson (Boston University, Supervisor: Tom Bania) was awarded $12,841 for work related to proposal GBT09B-002, **"Discovering Milky Way HII Regions"**
- Claire Gilpin (Franklin and Marshall College, Supervisor: Fronefield Crawford) was awarded $4,800 for work related to proposal GBT09B-003, **"On the Trail of the Enigmatic Millisecond Binary Pulsar PSR J1723-28"**
- Damon Farnsworth (University of Minnesota, Supervisor: Larry Rudnick) was awarded $25,200 for work related to proposal GBT09B-012,

"Relativistic Probes of the WHIM (redux)"

- Joshua Miller (West Virginia University, Supervisor: Maura McLaughlin) was awarded $22,400 for work related to proposal GBT09B-028, **"Timing of New and Old Rotating Radio Transient Sources"**
- Sanchayeeta Borthakur (University of Massachusetts, Supervisor: Min Yun) was awarded $16,970 for work related to proposal VLBA09B-126, **"Probing the Fundamental Sizes of HI Clouds in External Galaxies at . . . ."**

Approved Joint Fermi/NRAO Cycle 2 Proposals

Joan Wrobel and Toney Minter

Recognizing that radio observations using the NRAO facilities will be important to the scientific exploration by the Fermi Gamma-ray Space Telescope, up to 10% of the total observing time on each NRAO telescope was made available for joint observing. **http://fermi.gsfc.nasa.gov/ssc/proposals/nrao.html**

Fermi Cycle 2 observing will begin in 2009 August. The following joint Fermi/NRAO proposals were approved for Cycle 2.

- Fernando Camilo, Columbia University, **"Green Bank Telescope Timing of Key Fermi Pulsars"**, 116 GBT hours
- Teddy Cheung, NASA/GSFC, **"Radio/X-ray Study of High-Latitude Unidentified Fermi-LAT Objects (UFOS)"**, 8 VLA hours
- Michael Corcoran, NASA/GSFC, **"Observations of Gammy-ray Emission from Eta Car and WR 140"**, 12 VLA hours
- Eric Gotthelf, Columbia University, **"X-ray and Gamma-ray Timing and Spectral studies of Five Radio Quiet Pulsars"**, 8 GBT hours
- Fiona Harrison, Caltech, **"GRB Energetics in the Fermi Era"**, 90 VLA hours
- Svetlana Jorstad, Boston University, **"Correlation Between Gamma-ray Variations and Disturbances in the Jets of Blazar"**s, 96 VLBA hours, 15 VLA hours
- Yuri Kovalev, Max-Planck-Institut fuer Radioastronomie, **"Follow-up Study of the Brightest Gamma-ray flares in Fermi Blazars,"** 160 VLBA hours
- Maura McLaughlin, West Virginia University**", Constraining Pulsar Emission Physics Through Radio/Gamma-ray Correlation of Crab Giant Pulses"**, 30 GBT hours
- Scott Ransom, NRAO, **"Searching for Radio Pulsars in Fermi Bright Unidentified Sources"**, 27 GBT hours
- Paul Ray, Naval Research Laboratory, Search for Radio Pulsations from Gamma-ray Pulsars Discovered with Fermi, 16 GBT hours
- Mallory Roberts, Eureka Scientific Inc, **"A Pulsar Survey of Fermi Sources Not in the Bright Source List,"** 30 GBT hours
- Greg Taylor, University of New Mexico, **"The Parsec-scale Characteristics of Fermi AGN"**, 33 VLBA hours.

ALMA Construction

Al Wootten

Figure 1. Antenna testing in the 3 contractor camps continued under thin winter clouds at the OSF. On the right, a third antenna has been moved outside the Vertex facility. In the center, the three Melco antennas are being tested. On the left is the AEM camp, where construction of the first European antenna is under way. Photo © Denis Barkats.

Figure 2: Excavation has begun on the new Santiago Central Office for the Joint ALMA Observatory, adjacent to the ESO offices in Vitacura. © ALMA (ESO/NAOJ/NRAO)

Interferometry at the Operations Support Facility (OSF) with the first two antennas on their 69.7m baseline continued under the guidance of Joint ALMA Office (JAO) personnel after the first dynamic fringes were obtained. Fringes were demonstrated at 1.3mm during the period as instrumental and software tests continued.

A second single baseline correlator, previously used at the Antenna Test Facility on the NRAO VLA site in New Mexico, was updated and delivered to the OSF from the NRAO Central Development Laboratory as preparations there were made to ship the second quadrant of the 64 antenna correlator.

The first of the water vapor radiometers delivered by ESO was deployed for atmospheric water vapor measurements through a window in one of the buildings. Measurement of 0.75 mm of precipitable water vapor on 4 July over the 2900m elevation site suggested observations could be made for the first time in the deep submillimeter Band 9 (0.45 mm). A beam profile of Jupiter was made with both of the first two antennas.

Some astronomical validation tests have now been achieved at the OSF with all four bands installed in the dewar. Total power tests of the third, most recently accepted antenna continued and a third front end dewar was installed for radiometric tests. As this is the first austral winter available for antenna testing, advantage was taken of the cooler night temperatures to investigate surface performance of antennas still in the contractor

camps; the next of the twelve antennas in those camps at the site are scheduled to be accepted during August.

Preparations for operations at the 5000m Array Operations Site (AOS) continue. At the NRAO CDL in Charlottesville the first element of the critical Central Local Oscillator (LO) system passed its tests and was shipped to the AOS for installation. Providing reference signals to sixteen antennas, this system is key to multi-antenna interferometry. With 86 foundations now past provisional acceptance at the AOS the critical electrical and fiber optic cable connections from those pads to the AOS Technical Building (TB) have begun. Station 106, near that building, will receive its first antenna for tests soon and is the first to have been connected to the TB.

In Santiago, the JAO has been spread over several buildings, and a lease will soon expire on one. Accordingly, the effort to provide a permanent home adjacent to the ESO offices in nearby Vitacura has proceeded, led by ESO. Preparatory work—the resiting of eleven mature trees elsewhere on the property—has been completed. Early in July, excavation work began for the Santiago Central Office building to house the JAO. The building will include almost 7000 square meters of space on two floors, with underground parking for 130 vehicles. This additional parking allows some surface parking to be restored to green space. Construction is expected to last several years.

Common Astronomy Software Applications Update

CASA Team

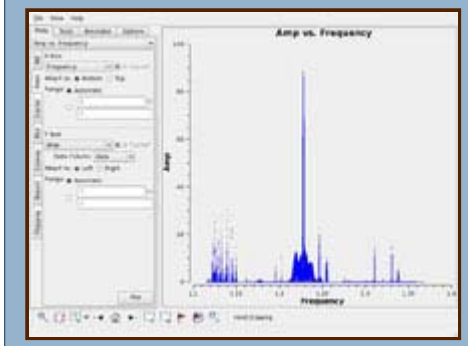

Figure 1: Screen capture of the new Qt based plotter showing EVLA WIDAR correlator data over a 200 MHz bandpass centered at 1.23 GHz. While still under development, this new plotter is at least an order of magnitude faster than the older matplotlib plotter (plotxy). Expanded capability will be available for release 3.0.0.

Figure 2: Australia Telescope Compact Array + Parkes image of Centaurus A comprised of 406 individual pointings. The image was created in CASA with multiscale clean. Image courtesy Ilana Feain, Tim Cornwell, & Ron Ekers (CSIRO/ATNF), R. Morganti (ASTRON), N. Junkes (MPIfR). See .

The Common Astronomy Software Applications (CASA) package being developed by NRAO and ALMA will be used for offline reduction and analysis of both ALMA and EVLA data. CASA is fully scriptable and offers a growing suite of data reduction tasks written in C++ with a Python interface, plotting through matplotlib, and a Qt-based Viewer and new experimental plotter (plotms, see Figure 1).

CASA is now being used regularly for ALMA commissioning in Chile, and to fill and inspect data from the new EVLA correlator. Over the last year, CASA tutorials have been held in Santiago, Chile; Socorro, NM; Garching, Germany; Mitaka, Japan; Hamilton, Canada; and Paris, France; reaching ~ 200 participants. Additional tutorials are planned for 2010 and beyond. CASA supports direct import of data in ALMA, VLA, and EVLA formats, and almost any data that can be written to uv-fits can also be imported and reduced (e.g., BIMA, CARMA, SMA, ATCA [see Figure 2]).

The CASA package is currently on Beta release version 2.4.0, and is available to the astronomical community for download from the **http://my.nrao.edu** website, after registration. A CASA helpdesk is also available from the same site. Please try CASA on your own data and join us in our efforts to improve and expand its capabilities. More information on the status of CASA, and its current capabilities can be found at **http://casa.nrao.edu**. Example scripts and data to get you started can also be found at this website.

The next release of CASA (release 3.0.0), expected shortly before January 2010, will be used to process early science data from the new EVLA WIDAR correlator, and will be the first non-beta release.

Binary Black Hole Surprises

Ari Laor and Joan Wrobel

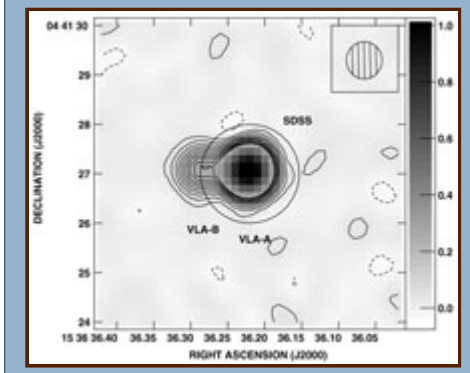

Figure 1: VLA image from [3] of Stokes I emission from SDSS J1536+0441 at a frequency of 8.5 GHz and spanning 6 arcsec (31 kpc). SDSS position is marked with a circle of radius 1 arcsec. Labels identify sources VLA-A and VLA-B. The rms noise is 0.013 mJy/beam (1 sigma) and the geometric-mean beamwidth is 0.73 arcsec (3.8 kpc) at FWHM. Contours are at -6, -4, -2, 2, 4, 6, 8, 10, 12, ... 20 times sigma. Negative and positive contours are dashed and solid, respectively. Image peak is 1.15 mJy/beam. Linear gray scale spans -0.05 to 1.0 mJy/beam.

Binary black hole systems with subparsec scales are predicted in merging scenarios for galaxy evolution and also factor prominently in predictions for the gravitational wave background. But do such binary systems exist? Twitter has been atwitter over the past few months following the astro-ph announcement in January that such a system may have been found by Boroson & Lauer [1].

The quasar SDSS J1536+0441, at a redshift of ~ 0.4, shows two broad-line emission systems [1]. One interpretation is that the emission lines are caused by a binary system of two black holes, with masses of about 10^7 and 10^9 solar masses separated by ~ 0.1 pc (0.02 mas) with an orbital period of ~ 100 years. The subparsec scale is significant, as it implies that this black hole system has solved its so-called final parsec problem, in contrast to the 7 pc binary in a radio galaxy [2]. Boroson & Lauer use the quasar's SDSS localization region to rule out a superposition of two unrelated quasars.

At meetings in March and April, we [3] announced the surprising VLA discovery of a 1 arcsec double source within the SDSS localization region (see Figure), suggesting a second interpretation for the emission lines: a 5 kpc binary quasar hosting VLA-A and VLA-B. Word rapidly circulated at those meetings about a Palomar telegram reporting a third broad-line emission component [4], suggesting a third interpretation as a so-called double-peaked emitter (DPE). A DPE is thought to originate from a geometrically thin Keplerian gaseous disk (also proposed for SDSS J1536+0441 by [5]). Importantly, no velocity drifts were detected between the epochs separating the SDSS and Palomar spectra [4], seemingly inconsistent with the interpretation as a subparsec binary system [1].

Then, in late May, an ESO/VLT telegram announced that each radio source had a 2 micron counterpart with a 2micron-to-radio ratio that was characteristic of a quasar [6]. This endorsed our [3] interpretation of SDSS J1536+0441 as a 5 kpc binary quasar.

Meanwhile, Boroson & Lauer regrouped as Lauer & Boroson and presented, at the end of May, HST WFPC2/PC images and KPNO 4-m longslit spectra of SDSS J1536+0441 [7]. Their images showed that the companion coincident with VLA-B was an elliptical galaxy. Significantly, the spectra, obtained with an east-west slit, showed no spatial offsets among the broad-line emission systems. Thus the companion elliptical galaxy could not host any of the broad-line gas. For this reason, SDSS J1536+0441 itself could not be explained as a superposition of separate broad-line objects hosting VLA-A and VLA-B. Alas, the interpretation of a 5 kpc binary quasar [3,6] bit the dust!

As reported in June [8], a high quality Keck spectrum of SDSS J1536+0441 excludes even better both spatial shifts in the broad-line light entering the slit and drifts of the broad-line peaks over time. These traits reinforce the difficulties with both the 5 kpc binary [3,6] and 0.1 pc binary [1] interpretations. A DPE interpretation for SDSS J1536+0441 remains viable but is not free of complications: DPEs always produce two nice broad peaks, while here the blue peak is narrow and strong, not the way a DPE produced by a Keplerian disk should appear. This has led to SDSS J1536+0441 being billed as an unusual DPE [8] and the theorists are enjoying the challenge of trying to understand its properties, including its radio-quiet nature [3]. The companion elliptical galaxy is also somewhat unusual, being a low-power radio galaxy [7].

Twitter has calmed down on the Boroson & Lauer binary black hole system, but we will surely hear more about this puzzling system. The Holy Grail of a binary black hole system with a subparsec scale is probably still out there. We'll be watching astro-ph for an announcement of its discovery!

[1] Boroson, T. A., & Lauer, T. R. 2009, Nature, 458, 53
[2] Rodriguez, C., et al. 2006, ApJ, 646, 49
[3] Wrobel, J. M., & Laor, A. 2009, ApJ, 699, L22
[4] Chornock, R. et al. 2009, The Astronomer's Telegram 1955
[5] Gaskell. M. 2009, Nature, submitted, 0903.4447
[6] Decarli, R., et al. 2009, The Astronomer's Telegram 2061
[7] Lauer, T. R., & Boroson, T. A. 2009, ApJ, submitted, 0906.0020
[8] Chornock, R., et al. 2009, ApJL, submitted, 0906.0849

Happy Birthday AIPS

Claire Chandler

The AIPS software package turned 30 years old on July 1, 2009. It is still going strong, although with modest manpower. The semi-annual progress report for the 31DEC09 release is available at:
ftp://ftp.aoc.nrao.edu/pub/software/aips/TEXT/PUBL/LET09A.PDF

Full information about AIPS can be found at the AIPS home page (**http://www.aips.nrao.edu/**) including links to three new AIPS Memos. They discuss an improved imaging geometry, the FITS-IDI convention, and auto-boxing during Clean (and elsewhere) in AIPS.

NRAO Archives Announces New Web Resource

E.N. Bouton

Kevin C. Westfold

The NRAO Archives is pleased to announce a **new Internet resource, Early Radio Astronomy Courses**, which currently includes lecture notes

for courses taught by Hendrik C. van de Hulst (1918-2000) and by Kevin C. Westfold (1921-2001).

The first known academic course specifically on radio astronomy was taught by van de Hulst, first at Leiden in Fall 1950, then again in Spring semester 1951 as Astronomy 241b at Harvard University, where van de Hulst was a Visiting Professor. By chance, it was during this very period that H.I. Ewen and E.M. Purcell discovered the 21 cm hydrogen line that van de Hulst had predicted in 1944. Professor van de Hulst notes in his introduction that, "The lectures were intended to make graduate students in astronomy and physics appreciate the problems and possibilities of radio astronomy and to give them a survey of the results."

Another early course in radio astronomy was given at the California Institute of Technology in both the Spring and Fall terms of 1958 as Astronomy 133 by Westfold, then a Visiting Professor on leave from the CSIRO Radiophysics Division, Sydney. These notes focus much more on the theoretical aspects of radio emission.

The NRAO Archives thanks Drs. Barry Clark, W. Miller Goss, and Woodruff T. Sullivan III for their help in making these courses available. We would be pleased to add additional early radio astronomy course notes to the Web page; please contact Ellen Bouton, Archivist, to discuss the potential addition of other course notes.

Career Opportunities

Test Scientists - ALMA: ALMA is opening positions for Test Scientists to participate in system tests during the Assembly, Integration and Verification processes. Test Scientists will be part of the team responsible for ensuring that appropriate testing has been accomplished to verify that the system requirements have been met including developing qualification tests, analyzing results and approving reports. The positions are based in Santiago, Chile and will require frequent travel to the ALMA Operational Support Facility near San Pedro, Atacama.

Web Analyst/Developer: The North American ALMA Science Center is seeking a Web Analyst/Developer to work in consultation with observatory scientific, technical, and design staff to plan, develop, and maintain websites and web portals that communicate technical information to external users of observatory research facilities.